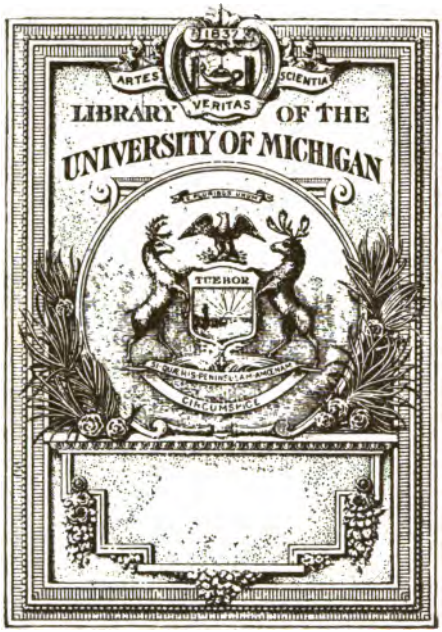

JUNIOR HIGH SCHOOL MATHEMATICS

BOOK I

BY

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PREFACE

During the first six grades the pupil has learned to compute with some skill, using whole numbers, fractions, and decimals. The work of these grades was necessarily centered around an arithmetical topic and the pupil had but little opportunity to apply his knowledge except to problems involving the topics studied. But to continue such a division of topics results not only in a loss of interest in the subject, but in a very inadequate training in using mathematics to answer the quantitative questions that necessarily arise in the varied interests and activities of life.

This series of mathematical textbooks assumes a knowledge of the arithmetical processes, and after a brief review of them in **Book I** the entire series centers the thought about some social issue and uses whatever mathematics is needed to answer the questions that naturally arise in an intelligent study of the issue. Such an arrangement is used not merely to give an increased interest in the study, but to develop the power to apply mathematics to the quantitative phases of life and to develop the habit of raising questions needed to interpret more fully the quantitative side of life.

It should be noticed, then, that this series especially emphasizes the interpretative power of mathematics and seeks to develop both the power to see and the habit of seeing the quantitative relationships that necessarily arise in topics of general conversation and reading. This necessarily involves the use of large numbers, for our newspapers and magazines are now full of such numbers in their discussions of the production and consumption of the world's necessities. Hence, certain chapters involving such numbers are given, in order to train the pupil to interpret them more intelligently. Furthermore, the series makes use, without so

labeling them, of concepts usually classed as arithmetic, algebra, geometry, and trigonometry.

Book I applies arithmetic to many topics of personal, home, and community interests, and to larger topics of general public interest. Constructive geometry is used to interpret many designs and patterns met on every hand, and mensuration leads to a use and an understanding of the formulas to express quantitative relationships. Such a selection of topics and the nature of the problems must not be confused with the mere thought of motivation used in selecting many of the problems of the lower grades. Mathematics is used in this series to answer some necessary social question, and a social question is not used merely to motivate mathematics.

The data for the problems are taken from reliable sources, as state and government reports and such current magazines as *The World's Work*, *The Literary Digest*, *The National Geographic Magazine*, *American Forestry*, *The Country Gentleman*, etc. These data, together with the results obtained from the problems, furnish valuable lessons in themselves. The prices given in the problems are those of 1918, when the series was being prepared. Properly used, then, this series of textbooks will give an interpretative power to mathematics not developed by the methods and problem material of the present type of textbooks written for these grades.

JOHN C. STONE

January, 1919

SUGGESTIONS TO TEACHERS

THIS book marks a new type of mathematics as to aims and purposes. It is an attempt to socialize the subject and to develop in the student the habit of using his mathematics in studying the topics of ordinary conversation and general reading. To develop this habit and the power so to use it, the arrangement and the material are entirely new. Mathematics is used here, as in life, to answer some necessary question arising out of some social issue of general interest, instead of some social issue being used to furnish a motive for learning mathematics. For this reason it seems wise to offer a few brief suggestions as to the use to be made of the various chapters.

1. Chapter I not only furnishes drill to develop greater skill, but shows the fundamental principles involved in computation. This is done better by grouping all of each process under one topic rather than grouping as whole numbers, fractions, and decimals. Show the student clearly that as long as the meaning of a process does not change, the principles governing the process are the same.

Impress the class with the importance of checking all work and insist throughout the course that all computation be thoroughly checked and one hundred per cent accurate when handed in as classroom work. Show them that this is just what a clerk or an accountant has to do in life if he is to hold his position.

2. Chapter II is to show the advantage of graphs in representing the relative values of data. Impress upon the class the value and importance of the subject by bringing in illustrations from magazines, newspapers, and textbooks in other studies. Since the purpose of a graph is to make relations more vivid than figures alone can do, the subject is of no value unless made so clear that this is true of it. Continue to use graphs throughout the course, as suggested in the text, until the pupil can interpret and construct them with ease. The graphs given here are of the simplest type. **Book II** discusses the subject much more fully.

3. Chapter III is to develop the habit of applying mathematics to personal and local situations. Before beginning the problems of this chapter and of all succeeding chapters, discuss the importance of each topic as suggested by the paragraph preceding them. Encourage the students to use mathematics in the ordinary affairs of life by having them bring in problems met in their own experiences. These, however, must not be problems merely to involve computation, but must be unavoidable problems that had to be solved to answer some necessary social issue. Encourage the students to discuss the topics at home and thus get the coöperation of the parents in gathering new data.

4. Chapter IV deals with the industries of greatest public interest. This necessarily involves the use of large numbers that the student meets in general reading. To interpret intelligently such numbers he must learn to see the relations among them as readily as with smaller numbers. This, however, should not be difficult, for the relation of 18 millions to 2 millions is no harder to see than the relation of 18 of any unit to 2 of the same unit. Show the student clearly that when the relation (quotient) of two large numbers is required, but a part of the figures need be used. Thus, the relation of 27,565,329 to 9,206,718 is *nearly* the same as the relation of 27 to 9, or of 275 to 92, etc.

Encourage the students to look for new data in their general reading. This will lead to a wider use of mathematics and to a more intelligent reading of current articles.

5. Chapter V is to encourage habits of thrift and economy. Show the students that to *know* whether or not one thing pays better than another we must apply mathematics. Whenever possible have the students supplement the problems of each group from their own personal experiences or from data gathered at home.

6. Chapter VI is to acquaint the student with business terms and forms met in conversation and general reading. There is no thought of preparing the student for a commercial pursuit, but to give him the knowledge needed by intelligent persons in order to interpret everyday references.

7. Chapter VII is given more to enable the student to interpret general conversation and reading than for immediate utilitarian value, for it will be several years before he is interested in actual investment. The social phase, then, is more important than the mathematical.

8. Chapter VIII is given to acquaint the student with terms often met in general reading and also to furnish him the knowledge through a few simple constructions by which he will be able to analyze and appreciate the simple geometric designs used in many common decorations. Have him study other forms found in patterns, window decorations, etc., and thus make this chapter a means of opening the student's eyes to forms and designs never observed before.

9. Chapter IX has the double purpose of furnishing a knowledge of the measurement of areas met on every hand and of introducing the formula as a means of representing a mathematical relation more briefly than through words. Do not work from mere formulæ, however, but through constructions have the pupil get a very concrete conception of all relations.

10. Chapter X, too, has a double purpose. Emphasize the use of the formula and make clear the changes in form, as removing parentheses, factoring, etc.

11. Chapter XI is to be used when greater skill in computation is desired. A few minutes daily is better than a whole period devoted to drill work. When daily drill is given in exercises of the same weight, a record of the number attempted and the number correct adds interest. This record may be kept in graphic form. The same exercises may be used many times. If so, no other drill work will be needed.

12. The author hopes, then, through this series of textbooks and the coöperation of teachers using it, to make mathematics a tool to interpret the quantitative relationships of matters of general conversation and reading rather than a mere collection of exercises for "mental discipline."

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JUNIOR HIGH SCHOOL MATHEMATICS

BOOK I

CHAPTER I

A REVIEW OF METHODS OF COMPUTATION

THE foundation of a course in mathematics is skill in arithmetical computations. But this is not an end in itself. The art of computation is only the tool that we use to solve the problems that arise in the world's varied activities.

Our knowledge of mathematics enables us to answer questions that arise about the entire quantitative side of life, such as buying, selling, and producing. These involve questions of economy and thrift, questions of investment, and various questions upon which our prosperity depends. But we must know that our answers to these questions are correct, otherwise they are of no value to us.

We can know that our results are correct only by going over the work until we obtain results that agree. The next time you make a purchase requiring written computation, notice that the clerk goes over the work a second time. This is called **checking the result.** Just as a clerk checks his work until he is practically sure that it is correct before turning in his sales slip, so should you check your work until you are practically sure that the computation is correct, before turning it in to the teacher. This chapter is to develop greater accuracy and speed in computation before taking up the problem side of the subject.

1. ADDITION: WHOLE NUMBERS, FRACTIONS, AND DECIMALS

Addition is the process of finding, without counting, a number equal in value to two or more other numbers, no matter whether they are whole numbers, fractions, or decimals. The two or more numbers to be added are called the **addends**, and the number equal in value to all the addends is called the **sum**.

All addition, whether it be of whole numbers, fractions, or decimals, depends upon the fundamental principle that only like numbers can be added.

Check all work in addition by adding a second time in reverse order.

Drill Exercises

1. *See how quickly you can call the forty-five sums.*
2. *See how quickly you can write the forty-five sums.*

2 8	4 5	2 9	2 3	1 7	3 3	6 9	1 3	2 5
3 9	1 1	5 5	4 6	3 7	5 6	1 9	8 9	4 8
2 2	5 7	1 6	7 7	2 4	1 2	6 8	3 6	7 9
5 9	3 8	6 6	3 4	5 8	4 7	2 6	8 8	1 4
1 8	4 4	2 7	6 7	1 5	3 5	7 8	4 9	9 9

Add and check without copying the numbers:

3.	4.	5.	6.	7.	8.
328	546	299	768	713	506
967	893	821	259	546	570
245	246	567	196	258	365
764	824	294	283	637	847
891	963	768	594	524	768
768	784	972	728	826	951

9. In adding decimals, why are the decimal points in the addends placed directly under each other?

10.	11.	12.	13.	14.	15.
24.96	96.3	9.64	10.86	64.26	76.28
43.8	87.43	18.23	57.09	58.93	93.7
16.27	5.16	48.21	98.17	47.6	32.48
9.68	17.9	17.8	3.88	9.98	9.23
53.09	46.83	7.65	16.09	7.16	71.16
84.7	57.74	93.87	81.7	54.9	1.82

Drill in Adding Long Columns

When the columns are long, the sum of each column is recorded as shown below.

CHECK		FIRST
59	3967	62
47	8478	48
48	9644	47
62	7939	59
64242	6429	64242
	7683	
	7468	
	5279	
	7355	
	64242	

EXPLANATION. — Beginning at the right, the sums are found and recorded as shown. Then the second addition usually begins at the left, and the sums are recorded as shown in the "check." If the sums of any two columns do not correspond, the error is found and corrected.

Drill Exercises

Add and check as shown above:

1.	2.	3.	4.	5.	6.
5968	7245	6783	9457	5896	7487
6394	5968	6847	5398	9657	4389
4682	5768	9352	4695	7684	7568
5496	8435	5968	7439	6749	4685
7538	9981	2757	6394	7856	4397
8496	6943	9386	5432	4684	7639
2157	3428	2719	6784	7396	4576
2896	3476	9298	4673	2849	6782
9617	8968	7431	5479	8632	7596
7463	5175	6827	9246	7865	4267
4628	3946	8753	4681	7295	6746
5179	8461	7384	7692	5319	4683

Adding Fractions and Mixed Numbers

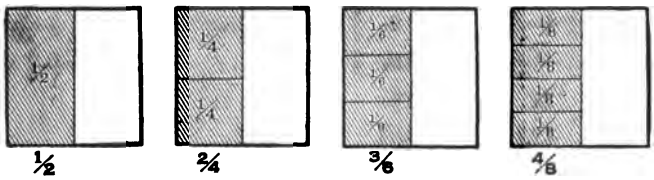
In fractions, the term above the line, or the **numerator,** is the *number of units*, and the term below the line, or the **denominator,** is the number that *names the units.* Thus, in the fraction $\frac{3}{5}$, the 3 shows "how many" and the 5 shows "what they are." That is, there are *three fifths.*

Fractions Reduced to Common Denominators

Since only like units can be added, fractions **must** be changed to a common denominator before they can be added.

The following diagram shows that every time the fractional unit is divided, the number of units is multiplied just

as many times as the number that denotes the name of the units:



Hence, *both terms of a fraction may be multiplied or divided by the same number without changing the value of the fraction.*

Thus, to change $\frac{2}{3}$, $\frac{3}{4}$, and $\frac{5}{6}$ to a common denominator, we see that 3, 4, and 6 are all factors of 12, so we change the fractions all to 12ths by multiplying both terms of $\frac{2}{3}$ by 4, of $\frac{3}{4}$ by 3, and of $\frac{5}{6}$ by 2.

Improper Fractions Changed to Whole or Mixed Numbers

When two or more fractions are added, the sum may be a fraction whose numerator is as large as, or larger than, the denominator. Such a result is called an **improper fraction** and should be changed to a **whole** or **mixed number.** Thus, $\frac{1}{2} + \frac{3}{4} + \frac{7}{8} = \frac{17}{8}$, an *improper fraction.*

Since there are but 8 *eighths* in any whole, 17 *eighths* are equal to 2 wholes, and 1 *eighth* more. That is, $\frac{17}{8} = 2\frac{1}{8}$, a *mixed number.*

Since the denominator is the number of parts in the whole, the numerator divided by the denominator gives the number of wholes in an improper fraction.

Drill Exercises

1. *Without copying the numbers, write the sums.*

2. *Write the sums a second time and compare the results. How accurate were you?*

3. $\frac{1}{2}+\frac{3}{4}+\frac{1}{8}$.
4. $\frac{2}{3}+\frac{5}{6}+\frac{1}{2}$.
5. $\frac{1}{3}+\frac{1}{6}+\frac{7}{12}$.
6. $\frac{3}{4}+\frac{1}{2}+\frac{5}{12}$.
7. $\frac{5}{8}+\frac{1}{2}+\frac{3}{16}$.
8. $\frac{3}{4}+\frac{2}{3}+\frac{1}{12}$.
9. $\frac{5}{6}+\frac{1}{4}+\frac{7}{12}$.
10. $\frac{2}{3}+\frac{1}{9}+\frac{5}{18}$.
11. $\frac{1}{4}+\frac{1}{2}+\frac{7}{8}$.
12. $\frac{5}{8}+\frac{3}{4}+1\frac{1}{16}$.
13. $\frac{3}{5}+\frac{7}{15}+\frac{2}{3}$.
14. $\frac{2}{9}+\frac{5}{6}+\frac{2}{3}$.

15.	16.	17.	18.	19.	20.
$12\frac{1}{2}$	$42\frac{2}{3}$	$46\frac{1}{4}$	$26\frac{1}{2}$	$54\frac{3}{4}$	$34\frac{1}{4}$
$26\frac{1}{4}$	$56\frac{1}{2}$	$52\frac{1}{8}$	$16\frac{3}{4}$	$16\frac{1}{2}$	$52\frac{1}{8}$
$17\frac{1}{2}$	$12\frac{1}{3}$	$12\frac{1}{2}$	$31\frac{1}{4}$	$17\frac{1}{8}$	$17\frac{5}{8}$
$24\frac{3}{4}$	$14\frac{5}{6}$	$16\frac{5}{8}$	$52\frac{1}{8}$	$42\frac{1}{4}$	$17\frac{1}{4}$
$42\frac{1}{2}$	$23\frac{1}{6}$	$42\frac{1}{2}$	$17\frac{1}{2}$	$16\frac{5}{8}$	$52\frac{1}{2}$

NOTE. — In exercises like those from 15 to 20 inclusive, it is simpler to add the like fractions first, then add their sums.

21.	22.	23.	24.	25.	26.
$16\frac{2}{3}$	$17\frac{3}{4}$	$42\frac{1}{5}$	$16\frac{2}{3}$	$42\frac{3}{4}$	$16\frac{1}{2}$
$21\frac{1}{4}$	$19\frac{3}{8}$	$16\frac{1}{3}$	$21\frac{1}{6}$	$13\frac{1}{2}$	$27\frac{5}{8}$
$38\frac{1}{2}$	$22\frac{1}{2}$	$28\frac{2}{3}$	$16\frac{1}{3}$	$14\frac{7}{8}$	$21\frac{3}{4}$
$26\frac{5}{6}$	$31\frac{7}{8}$	$36\frac{5}{6}$	$27\frac{2}{3}$	$21\frac{1}{2}$	$32\frac{3}{4}$
$53\frac{1}{8}$	$22\frac{1}{4}$	$21\frac{2}{3}$	$14\frac{1}{2}$	$16\frac{5}{8}$	$17\frac{1}{2}$
$16\frac{1}{2}$	$31\frac{1}{2}$	$42\frac{2}{5}$	$16\frac{5}{6}$	$17\frac{3}{4}$	$19\frac{7}{8}$

2. SUBTRACTION: WHOLE NUMBERS, FRACTIONS, AND DECIMALS

Subtraction is the inverse of addition. That is, the sum of two addends and one of the two addends are given, and the other addend is to be found. The given sum is the **minuend.** The given addend is the **subtrahend.** The addend found is the **difference** or **remainder.**

To **check** subtraction, add the result to the subtrahend and see if it equals the minuend.

Drill Exercises

1. *See how quickly you can call the eighty-one differences.*
2. *See how quickly you can write the eighty-one differences.*

5 1	6 4	7 1	7 2	7 4	6 2	8 3	10 9	8 2
6 5	4 2	7 3	6 3	5 3	8 1	3 2	17 9	4 3
9 4	8 6	10 1	10 8	9 1	9 6	10 6	8 7	11 2
10 4	14 5	9 5	13 6	10 7	14 7	11 7	13 4	12 4
12 7	9 8	12 5	11 5	13 5	12 3	9 7	13 7	11 4
11 6	12 6	14 6	16 7	10 5	15 9	11 8	12 8	10 4
8 5	18 9	10 2	9 3	2 1	7 5	6 1	13 9	15 6
3 1	8 4	7 6	9 2	11 3	5 4	17 8	12 9	16 8
14 8	15 8	4 1	10 3	14 9	15 7	16 9	13 8	11 9

Subtract and check the results:

3.	4.	5.	6.	7.	8.
46,028	28,103	42,201	50,726	60,403	50,170
17,[illegible]	19,674	16,788	19,879	46,725	16,893

9.	10.	11.	12.	13.	14.
[illegible]	[illegible]	[illegible]	70,1[illegible]	41,091	63,402
[illegible]	[illegible]	[illegible]	42,268	1[illegible]	49,576

15.	16.	17.	18.	19.	20.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	290.00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	277.42

21.	22.	23.	24.	25.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

26.	27.	28.	29.	30.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

31.	32.	33.	34.	35.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

3. MULTIPLICATION OF WHOLE NUMBERS, FRACTIONS, AND DECIMALS

[illegible]

Multiplying by a Whole Number

Multiplying by a whole number is a short way of finding the sum of a number of equal addends, and the meaning is always the same whether the number multiplied is a whole number, a fraction, or a decimal.

Thus, $5 \times \$75 = \$75 + \$75 + \$75 + \$75 + \$75 = \$375$;
$5 \times 1.43 = 1.43 + 1.43 + 1.43 + 1.43 + 1.43 = 7.15$; and
$5 \times \frac{3}{8} = \frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8} + \frac{3}{8} = \frac{15}{8} = 1\frac{7}{8}$.

5 is the **multiplier** in each; \$75, 1.43, and $\frac{3}{8}$ are the **multiplicands**; and \$375, 7.15, and $1\frac{7}{8}$ are the **products**.

From the meaning of multiplication, the following principles are evident:

1. *The multiplier must be an abstract number: that is, one used without reference to any particular object.*

2. *The multiplicand may be either an abstract number, or a concrete number: that is, a number of specified objects.*

3. *The product must be a number like the multiplicand.*

NOTE. — In practical work use the smallest factor as multiplier. Thus, in either 3 × \$245 or 245 × \$3, use 3 as the actual multiplier.

Check multiplication by going over the work a second time. If multiplier and multiplicand can be interchanged conveniently, as when both consist of about the same number of figures, it is a better check to interchange them. Any process, however, that assures us that our work is correct, is a check.

Drill Exercises

Multiply and check:

1. 385×647.	5. 627×439.	9. 534×847.
2. 978×436.	6. 835×764.	10. 672×478.
3. 682×497.	7. 829×467.	11. 768×309.
4. 573×698.	8. 932×827.	12. 846×708.

13. Find $24 \times 375\frac{3}{5}$.

WORK

$375\frac{3}{5}$

24

$5)72$

$14\frac{2}{5} = 24 \times \frac{3}{5}$

$1500 = 4 \times 375$

$750 = 20 \times 375$

$9014\frac{2}{5}$

14. $36 \times 278\frac{3}{4}$.

15. $27 \times 963\frac{1}{2}$.

16. $84 \times 726\frac{3}{8}$.

17. $75 \times 175\frac{3}{4}$.

18. $25 \times 693\frac{2}{3}$.

19. $42 \times 785\frac{2}{5}$.

20. $86 \times 635\frac{3}{7}$.

21. 38×1.67.

22. 52×9.38.

23. 65×96.3.

24. 84×7.69.

25. 86×3.58.

26. 94×9.63.

27. 65×76.9.

28. 48×9.63.

29. 94×8.76.

Meaning of Multiplying by a Fraction

You have seen that multiplying by a whole number was to save writing the multiplicand a certain number of times and adding. But a number cannot be written $\frac{3}{4}$ of a time and added. Multiplying by a fraction requires both a division and a multiplication. To multiply by $\frac{3}{4}$ is to divide by 4 and multiply by 3. In practice the multiplication is performed before the division.

Drill Exercises

Multiply and check:

1. $\frac{3}{4} \times 965$.

2. $\frac{2}{3} \times 784$.

3. $\frac{5}{6} \times 963$.

4. $\frac{7}{8} \times 327$.

5. $3\frac{1}{2} \times 729$.

6. $5\frac{3}{4} \times 624$.

7. $6\frac{2}{3} \times 926$.

8. $7\frac{2}{5} \times 643$.

9. $8\frac{3}{4} \times 268$.

10. $9\frac{1}{3} \times 349$.

11. $6\frac{2}{5} \times 649$.

12. $7\frac{1}{2} \times 327$.

Multiplying a Fraction by a Fraction

You have learned in the lower grades that when multiplying two fractions,

The product of the numerators is the numerator of the result, and the product of the denominators is the denominator of the result.

To save reducing the result to *lowest terms*, like factors are **cancelled** before multiplying.

Drill Exercises

Multiply and check, using cancellation:

1. $\frac{3}{4} \times \frac{12}{17}$.
2. $\frac{2}{5} \times \frac{15}{16}$.
3. $\frac{2}{3} \times \frac{9}{10}$.
4. $\frac{5}{6} \times \frac{9}{10}$.
5. $\frac{7}{8} \times \frac{16}{21}$.
6. $\frac{5}{7} \times \frac{14}{15}$.
7. $\frac{8}{9} \times \frac{9}{32}$.
8. $\frac{7}{9} \times \frac{27}{35}$.
9. $\frac{5}{6} \times \frac{24}{25}$.
10. $\frac{11}{12} \times \frac{36}{55}$.
11. $\frac{9}{13} \times \frac{26}{27}$.
12. $\frac{8}{11} \times \frac{22}{56}$.

Multiplying by a Decimal

You have learned in the lower grades that when multiplying decimals,

The number of decimal places in the product is the sum of the number of places in the factors multiplied.

Drill Exercises

1. $.8 \times 34.6$.
2. $.9 \times 8.75$.
3. $.7 \times 62.3$.
4. $.8 \times 4.65$.
5. $.5 \times 76.3$.
6. 1.9×26.8.
7. 2.4×1.76.
8. 3.8×9.63.
9. $.48 \times 26.2$.
10. $.57 \times 96.3$.
11. 9.6×8.48.
12. 7.2×93.6.
13. $.85 \times 96.3$.
14. $.98 \times 74.6$.
15. $.76 \times 93.6$.

Finding a Per Cent of a Number

You have learned that **per cent** is only another name and notation for *hundredths*. So to find 7% of 340 is to find $.07 \times 340$; to find $4\frac{1}{2}\%$ of 560 is to find $.045 \times 560$; to find $3\frac{3}{4}\%$ of 300 is to find $.0375 \times 300$; to find 3.2% of 685 is to find $.032 \times 685$. When the per cent sign is removed, *two* more decimal places must be used.

Drill Exercises

Change to decimals:

1. 25%.	6. $4\frac{1}{2}$%.	11. 4.2%.	16. 125%.
2. 45%.	7. $12\frac{1}{2}$%.	12. 16.3%.	17. 140%.
3. 76%.	8. $6\frac{1}{4}$%.	13. 23.6%.	18. 250%.
4. 95%.	9. $15\frac{3}{4}$%.	14. 3.45%.	19. 165%.
5. 48%.	10. $20\frac{1}{2}$%.	15. 6.12%.	20. 275%.

Find:

21. 8% of 575.	27. $3\frac{1}{2}$% of 780.	33. 3.2% of 465.
22. 9% of 768.	28. $4\frac{1}{2}$% of 576.	34. 8.3% of 575.
23. 5% of 963.	29. $8\frac{1}{2}$% of 698.	35. 7.4% of 623.
24. 6% of 764.	30. $2\frac{1}{4}$% of 480.	36. 8.9% of 450.
25. 7% of 685.	31. $3\frac{1}{4}$% of 762.	37. 2.6% of 575.
26. 3% of 967.	32. $7\frac{3}{4}$% of 896.	38. 5.2% of 680.

4. DIVISION: WHOLE NUMBERS, FRACTIONS, AND DECIMALS

Division is the inverse of multiplication. That is, having given the product of two numbers and one of them, division is the process of finding the other. The given product is called the **dividend**, the other given number is the **divisor**, and the number to be found is the **quotient**. If the dividend is not exactly divisible by the divisor, the amount by which the dividend is too large for exact division is called the **remainder**.

Two Meanings of Division

To divide \$35 by \$5 is to find how many times \$5 can be taken from \$35, or to find how many times as large \$35 is as \$5. That is, it is a sort of *measuring* to find how many times \$35 will contain \$5. This is the **measurement** meaning of division.

In the measurement kind of division, both dividend and divisor must be like numbers, and the quotient shows the relation of the dividend to the divisor.

Thus, in 16 ft. ÷ 2 ft. = 8, the quotient 8 shows that the dividend 16 ft. is 8 times the divisor 2 ft.

In 2 ft. ÷ 16 ft. = .125, the quotient .125 shows that the dividend 2 ft. is but 125 thousandths of the divisor 16 ft., or $12\frac{1}{2}\%$ of it.

To divide \$35 by 5 is to find how large each part will be when \$35 is divided into 5 equal parts. That is, it is a method of separating the dividend into a number of equal parts to find the size of each part. This is the **partition** meaning of division.

In the partition kind of division, the divisor must be an abstract whole number and the quotient is the same kind of number as the dividend.

Thus, \$35 can be divided into 5 equal parts and there will be \$7 in each part. But it cannot be divided into $5\frac{1}{2}$ equal parts. Such an expression has no meaning.

But to divide \$35 by some number not a whole number, as 2.5, is simply to find a quotient of which \$35 is 2.5 times as large.

Division is checked:

1. *By performing the work a second time; or*
2. *By seeing if the product of the quotient and divisor, plus the remainder, equals the dividend.*

Drill Exercises

1. 576,345 ÷ 97.	5. 637,968 ÷ 74.	9. 596,873 ÷ 86.
2. 643,961 ÷ 76.	6. 697,846 ÷ 93.	10. 495,784 ÷ 65.
3. 824,376 ÷ 95.	7. 439,628 ÷ 67.	11. 657,163 ÷ 84.
4. 576,842 ÷ 86.	8. 556,346 ÷ 68.	12. 736,247 ÷ 95.

Division of Fractions

To divide any number by an abstract whole number is to find a part of it; thus, to divide a number by 5 is to find $\frac{1}{5}$ of the number; to divide it by 8 is to find $\frac{1}{8}$ of it, etc. So $\frac{2}{3} \div 8 = \frac{1}{8} \times \frac{2}{3} = \frac{1}{12}$; and $\frac{3}{5} \div 4 = \frac{1}{4} \times \frac{3}{5} = \frac{3}{20}$.

But since $6 \div 3$ gives the same quotient as $60 \div 30$ or $600 \div 300$, or $12 \div 6$, etc., it is seen that,

Both dividend and divisor may be multiplied by the same number without changing the quotient.

Hence, to divide $\frac{3}{4}$ by $\frac{2}{3}$, both terms may be multiplied by 3, then the divisor becomes the whole number 2, and the result is $\frac{9}{4} \div 2$ or $\frac{1}{2} \times \frac{9}{4}$. It is seen that this, just as when the divisor was a whole number, is equivalent to inverting the divisor and using it as a multiplier.

Thus, $\frac{5}{8} \div \frac{3}{4} = \frac{4}{3} \times \frac{5}{8} = \frac{5}{6}$; $\frac{3}{7} \div \frac{2}{5} = \frac{5}{2} \times \frac{3}{7} = \frac{15}{14} = 1\frac{1}{14}$.

Drill Exercises

Find:

1. $\frac{3}{4} \div \frac{2}{5}$.
2. $\frac{3}{7} \div \frac{5}{6}$.
3. $\frac{2}{9} \div \frac{3}{4}$.
4. $\frac{7}{8} \div \frac{5}{6}$.
5. $\frac{1}{4} \div \frac{2}{7}$.
6. $\frac{4}{5} \div \frac{2}{3}$.
7. $\frac{7}{8} \div \frac{5}{6}$.
8. $\frac{3}{4} \div \frac{9}{10}$.
9. $\frac{7}{8} \div \frac{2}{5}$.
10. $\frac{8}{9} \div \frac{2}{5}$.
11. $\frac{7}{8} \div \frac{2}{3}$.
12. $\frac{6}{7} \div \frac{5}{14}$.
13. $\frac{9}{10} \div 2$.
14. $\frac{7}{8} \div 2$.
15. $\frac{6}{7} \div 3$.
16. $\frac{12}{13} \div 8$.
17. $\frac{15}{19} \div 10$.
18. $\frac{9}{10} \div 6$.
19. $\frac{12}{17} \div 8$.
20. $\frac{24}{25} \div 18$.
21. $\frac{27}{31} \div 18$.
22. $\frac{16}{17} \div 12$.
23. $\frac{15}{22} \div 10$.
24. $\frac{11}{15} \div 33$.
25. Divide $2\frac{1}{2}$ by $3\frac{1}{4}$.

WORK

$2\frac{1}{2} = \frac{5}{2}$; $3\frac{1}{4} = \frac{13}{4}$

$\frac{5}{2} \div \frac{13}{4} = \frac{4}{13} \times \frac{5}{2} = \frac{10}{13}$.

EXPLANATION. — Mixed numbers, when the whole number is small, are most easily divided by first changing them to improper fractions.

Find:

26. $2\frac{1}{2} \div 1\frac{1}{4}$. **29.** $5\frac{1}{4} \div 1\frac{2}{5}$. **32.** $6\frac{2}{3} \div 2\frac{1}{5}$.

27. $3\frac{1}{2} \div 1\frac{2}{5}$. **30.** $6\frac{1}{3} \div 2\frac{3}{4}$. **33.** $4\frac{4}{5} \div 2\frac{1}{3}$.

28. $4\frac{1}{2} \div 2\frac{1}{4}$. **31.** $7\frac{1}{2} \div 3\frac{4}{5}$. **34.** $5\frac{5}{6} \div 2\frac{1}{2}$.

35. Divide $3467\frac{2}{3}$ by 8.

WORK

$8)\overline{3467\frac{2}{3}}$

$433,\ 3\frac{2}{3}$ rem.

$3\frac{2}{3} \div 8 = \frac{1}{8} \times \frac{11}{3} = \frac{11}{24}$.

Hence, $3467\frac{2}{3} \div 8 = 433\frac{11}{24}$.

EXPLANATION. — This differs from division of whole numbers only in expressing the remainder as a fractional part of the divisor. That is, the remainder $3\frac{2}{3}$ had to be divided by 8.

36. $396\frac{2}{3} \div 8$. **45.** $1065\frac{3}{4} \div 6$. **54.** $3804\frac{3}{8} \div 6$.

37. $746\frac{2}{5} \div 9$. **46.** $1635\frac{5}{8} \div 9$. **55.** $4150\frac{1}{3} \div 7$.

38. $375\frac{1}{2} \div 6$. **47.** $1062\frac{5}{6} \div 8$. **56.** $3062\frac{3}{4} \div 8$.

39. $576\frac{2}{3} \div 8$. **48.** $1207\frac{3}{5} \div 7$. **57.** $2964\frac{2}{3} \div 7$.

40. $754\frac{3}{4} \div 9$. **49.** $1096\frac{2}{7} \div 9$. **58.** $5206\frac{1}{6} \div 9$.

41. $1638\frac{3}{5} \div 8$. **50.** $1163\frac{5}{8} \div 5$. **59.** $2630\frac{5}{6} \div 7$.

42. $1347\frac{2}{3} \div 7$. **51.** $2463\frac{2}{5} \div 9$. **60.** $4670\frac{1}{2} \div 9$.

43. $2165\frac{4}{7} \div 8$. **52.** $3768\frac{2}{3} \div 8$. **61.** $5106\frac{5}{8} \div 5$.

44. $1362\frac{3}{4} \div 5$. **53.** $4267\frac{3}{7} \div 5$. **62.** $6147\frac{2}{7} \div 5$.

Division of Decimals

The only difficulty in the division of decimals is pointing off the quotient. But this gives no trouble when we remember that when dividing by an abstract whole number, the unit of the quotient is like the unit divided, for the division means *partition*. Thus, $\$8 \div 2 = \$4$; 8 ft. $\div 2 = 4$ ft.; $.8 \div 2 = .4$; $.08 \div 2 = .04$.

If the divisor is not a whole number, it may be made so by multiplying both dividend and divisor by the same power of 10, from the principle discussed in division of fractions.

Drill Exercises

13. .864. **15.** .016. **17.** 3.16. **19.** 1.9.

14. .358. **16.** 1.25. **18.** 2.08. **20.** 1.375.

21. Find what per cent $218.75 is of $8750.

WORK

$$.025 = 2.5\,\%$$

$8750)$218.750

175 00

437 50

437 50

EXPLANATION. — The relation of $218.75 to $8750 is wanted. Hence, $218.75 is the dividend and $8750 the divisor.

The relation is .025. That is, $218.75 is but .025 of $8750 or 2.5 % of it.

Find what per cent:

22. 45 is of 125. **27.** 3.5 is of 7.2. **32.** 24.6 is of 358.

23. 75 is of 320. **28.** 6.2 is of 9.35. **33.** 21.3 is of 17.6.

24. 128 is of 267. **29.** 7.6 is of 5.26. **34.** 6.43 is of 16.2.

25. 254 is of 375. **30.** 8.3 is of 6.27. **35.** 7.28 is of 325.

26. 116 is of 428. **31.** 98 is of 76.8. **36.** 1.89 is of .96.

37. When an article selling for $2.40 gave a profit of $.60, the profit was what per cent of the selling price?

38. When the school enrollment of 480 increases 72, the increase is what per cent of the former enrollment?

39. When the population of a town increases from 32,400 to 38,232, by how many has it increased? The increase is what per cent of the former population?

40. Automobiles selling for $1350 were increased to $1625. Find the per cent of increase.

41. A man's apple crop was 425 bushels one year and 510 bushels the next year. Find the per cent of increase.

42. A farmer's crop of potatoes yielded 180 bu. per acre one year and but 145 bu. the next year. Find the per cent of decrease.

Dividing by Large Numbers

In many problems that arise in life, the real divisor is a very large number; but the quotient is the same whether all the figures are used or not. There is no rule as to how many figures must be used; but, if one or two more figures are kept than the number of figures required in the quotient, the result is close enough for all ordinary purposes. Be careful to keep enough, and with practice you will come to see how many are needed in particular cases.

Drill Exercises

1. Divide 36,457,693 by 21,586,927, carrying the result to hundredths.

FULL WORK

1.69 nearly
21,586,927)36,457,693.00
21 586 927
14 870 766 0
12 952 156 2
1 918 609 80
1 942 823 43

ABRIDGED WORK

1.69 nearly
2158)3645.00
2158
1487 0
1294 8
192 20
194 22

EXPLANATION. — It was seen that 36 million will contain 21 million but once, thus a quotient "to hundredths" will have but three figures in it. Hence, four figures were kept in the divisor. That is, both dividend and divisor were divided by 10,000 and the remainders were not used in the division.

2. Find what per cent 18,368,275 is of 24,376,275, true to tenths of one per cent.

WORK

$.753 = 75.3\,\%$

2437)1836.000

1705 9

130 10

121 85

82 50

73 11

EXPLANATION. — It was seen that the first quotient figure is tenths, and as tenths of a per cent comes in thousandth place, there will be three figures required in the quotient. Hence, four figures were kept in the divisor.

Express as per cent true to tenths of one per cent:

3. 12,320,217 of 93,427,560.
4. 17,931,216 of 85,321,240.
5. 48,392,175 of 97,963,840.
6. 75,921,350 of 86,792,750.
7. 43,125,268 of 91,326,750.
8. 19,620,930 of 54,936,800.
9. 35,265,200 of 51,765,300.
10. 26,742,300 of 78,340,264.
11. 39,247,623 of 48,260,500.
12. 19,726,850 of 73,341,780.
13. 31,884,760 of 43,963,800.
14. 34,039,427 of 65,234,500.

15. Divide some of the above exercises, using all the figures, and see if the answer differs from the one you found by the abridged work.

16. Let the class divide into two groups and, as the teacher dictates long exercises in divisions, let one group divide using all the figures, and let the other group abridge the work, and see how nearly the answers agree.

17. In dividing 39,246.2753 by 8436.27, show clearly that if you cut off three figures in the divisor, you must cut off five in the dividend.

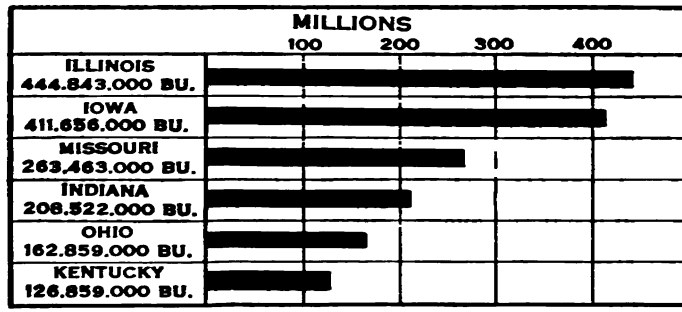
Divide, using only the figures necessary to get tenths:

18. 375.6 by 58.375.
19. 61.4 by 26.138.
20. 246.3758 by 96.124.
21. 17.6431 by 9.2865.
22. 11.4375 by 1.0923.
23. 1.9628 by .3165.

CHAPTER II

GRAPHIC REPRESENTATION OF DATA

Often a more vivid relation of numbers may be represented by lines. These are called **graphs**. Thus, the production of corn in a recent year in the six states leading in the production may be represented as follows:



1. INTERPRETING GRAPHS

1. By comparing the lines in the chart, tell about how many times as much corn was raised in Iowa as in Indiana.

2. The production of Indiana was about what part of that of Iowa? About what per cent of it?

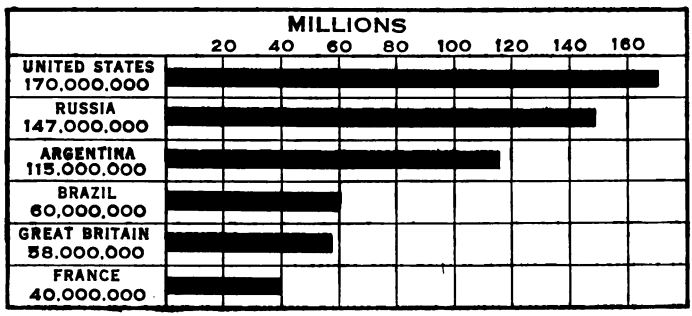
3. Missouri raised about how many times as much as Kentucky?

4. The production of Kentucky was about what per cent of that of Missouri?

5. From the chart, it appears that Iowa produced one half, or 50 %, more than Missouri. That is, the difference is about half that of Missouri. In the same way compare the production in Missouri with that of Indiana.

6. The production of Ohio is about what part of that of Illinois? About what per cent of it?

THE FOLLOWING GRAPH SHOWS THE NUMBER OF MEAT-PRODUCING ANIMALS IN THE FOLLOWING COUNTRIES IN 1915. THESE INCLUDE CATTLE, SHEEP, AND PIGS:



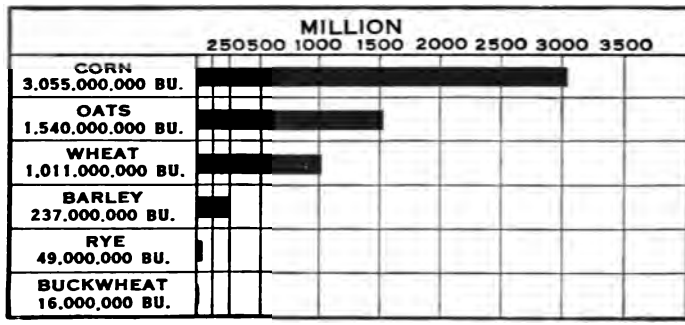
7. Compare the number of meat-producing animals in the United States with the number in Russia. In Argentina.

8. Compare the number in Argentina with the number in Brazil. The number in Brazil is about what per cent of the number in Argentina? Of the number in the United States?

9. France has about what part of the number in the United States? What per cent?

10. The United States has about how many times as many as Great Britain?

THE RELATIVE IMPORTANCE, IN NUMBER OF BUSHELS, OF THE LEADING SIX GRAIN CROPS IN THE UNITED STATES IN 1915 IS SHOWN BY THE FOLLOWING CHART:



11. Compare the corn crop with the oat crop.

12. The oat crop was about what per cent of the corn crop?

13. The wheat crop was about what fractional part of the corn crop? About what per cent?

14. The barley crop was about what per cent of the wheat crop?

15. Compare the rye crop with that of barley.

16. Compare, in per cent, the wheat crop with the oat crop.

2. CONSTRUCTING GRAPHS

You will find it very convenient and useful in presenting numerical facts to be able to present them graphically, for those to whom you present them will often get a much more vivid picture from a well-made graph than from words or figures. Besides your ruler, you will need a right triangle and a pair of compasses to mark off equal divisions and to draw parallel lines.

1. Show by a graph the relative values of our four leading exports during a recent year. They were: cotton, $610,000,000; foodstuffs, $430,000,000; iron and steel, $300,000,000; mineral oil, $152,000,000.

Before beginning the construction, answer the following questions:

a. How much must your longest line represent?

b. If you space the chart by perpendicular lines, as in the graphs you have studied, how many spaces are needed if each represents $100,000,000?

c. If you are to have seven spaces, how many perpendicular lines must you draw? (Use your right triangle in drawing these.)

d. If you decide to allow ½ inch to the space, how much must you allow for the seven spaces? Will your paper allow for this together with a space for the names of the exports? (Use your compasses in marking off equal spaces.)

e. Through how many spaces will the graph of each export extend?

2. In a recent year Russia produced 757,000,000 bushels of wheat; the United States, 704,000,000 bushels; British India, 368,000,000 bushels; and France, 324,000,000 bushels. Show the relative productions graphically.

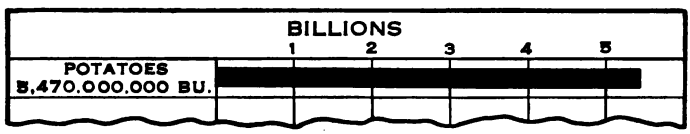
a. How many spaces will you need if each represents 100,000,000 bushels?

b. How many perpendicular lines will you need to mark off the spaces?

c. Your paper will allow what distance between lines?

3. Make a chart showing the relative importance, in the number of bushels raised, of the six leading world food crops, which are: potatoes, 5,470,000,000 bushels; oats, 4,349,000,000 bushels; wheat, 3,822,000,000 bushels; corn, 3,818,000,000 bushels; rye, 1,782,000,000 bushels; barley, 1,482,000,000 bushels.

Begin your chart as follows:

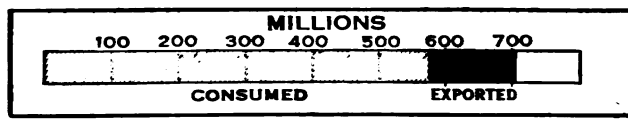


4. The five leading cane sugar producing countries in 1913 were: Cuba, 2,909,000 tons; India, 2,534,000 tons; Java, 1,591,000 tons; Hawaii, 612,000 tons; and Porto Rico, 398,000 tons. Show the relative productions graphically.

5. Graph statistics found in your geography lessons as your teacher may direct.

3. GRAPHIC REPRESENTATIONS OF THE RELATION OF A PART TO THE WHOLE

Instead of using different lines to show the relation of a part to the whole, a single line is often used and the parts are shown by shading. Thus, to show that in a recent year we exported 116,000,000 bushels of the 705,000,000 bushels of wheat raised, we could use a single bar as follows:



1. If the enrollment of your school is 450 and the average attendance but 380, show on a single bar the relations of the attendance and absences to the total enrollment.

2. Make a chart of horizontal bars like the one in the middle of the page, showing the following facts: From 1900 to 1910 27% of the counties of Virginia decreased in population; 44% of the counties of Ohio decreased; 61% of those of Indiana; and 72% of those of Iowa.

3. A coal dealer whose retail trade amounted to $18,000 paid out $4325 for freight and $4465 for delivery. Make a graph showing the part of the $18,000 paid out for freight and for delivery.

4. When several parts make up the whole and it is desirable to write the names of the parts, a perpendicular bar is often more convenient. Thus, a bar like the one in the margin is often used. This shows where we get our $74,000,000 worth of raw silk which in a recent year was distributed as follows: Japan, $44,100,000; Italy, $14,300,000; China, $12,200,000; France, $2,500,000; all other countries, $900,000.

5. Make a perpendicular bar graph and mark it as in problem 4, to show the following: The food we eat produces heat to heat the body and enable us to do work. It has been calculated that the distribution is as follows: about $\frac{3}{4}$ to heat the body; about $\frac{3}{16}$ to do the day's work; about $\frac{1}{16}$ for the heart; and about $\frac{1}{60}$ for respiration.

CHAPTER III

PERSONAL, HOME, AND COMMUNITY INTERESTS

There are many problems that arise in our daily lives that are directly concerned with our welfare. To be able to solve them will enable us to earn and save more, to spend more wisely, and to appreciate better many factors of community life.

1. EARNING MONEY

In many places pupils have opportunities to earn money during their out-of-school hours and during their summer vacations. Some time after we had entered the great World War, many boys and girls pledged themselves to buy a certain number of Thrift Stamps weekly, and earned the money with which they bought them.

1. A boy delivered packages for a butcher who had a cash-and-carry trade, collecting the amount of the bill from the customer and 7 ¢ additional for the delivery. In addition to the 7 ¢, the butcher paid him 2 % of the bills collected. One month he made 346 deliveries, collecting a total of $578. Find how much he earned.

2. A boy having a similar contract (problem 1) delivered for a grocery store, making an average of 86 deliveries and collecting $137 each week during the entire school year of 40 weeks. How much did he earn?

3. One summer a boy acted as caddie for a golf player at 25 ¢ per round, and also made 20 % of all sales of golf balls

and other supplies that he sold. One season he went 85 rounds and sold $63.45 worth of supplies. Find his total earnings.

4. A boy living in town took orders for brushes of all kinds, getting 40% of his sales. He worked an average of $2\frac{1}{2}$ hours for 45 afternoons; and the total amount of his orders was $286.40. Find how much per hour he made after deducting $3.80 for expenses connected with the delivery.

5. A girl solicited subscriptions for magazines one year. The total subscriptions amounted to $175.50. She got 40% of the subscription price and estimated that she worked a total of 80 hours. Find how much she earned per hour.

6. A girl living in the country sold fruit, vegetables, and fresh eggs to automobile parties passing her home. Her father paid her 25% of all she received. One summer she sold $348.40 worth of produce. How much did she earn?

7. For several years boys' and girls' clubs have accomplished much in the way of food production. In 1916 they produced an average of $20.96 worth of food for every boy or girl engaged in the work at a cost of 79¢ for supervision and instruction. If every one of the 23,000,000 boys and girls of school age could earn this average each year, to how much would it amount yearly?

8. A boy took orders after school for aluminum ware. One year he worked an average of $2\frac{1}{4}$ hours each afternoon for 38 days. His total sales amounted to $386.40 and his commission was 40%. Deducting $12.80 for expenses, how much did he earn per hour?

9. The Journal of Education, April 25, 1918, reported that the pupils of the Van Vlissingen School, Chicago, earned

CHAPTI

PERSONAL, HOME, AND

There are many problems t
are directly concerned with
them will enable us to ear
wisely, and to appreciate b
life.

1. EA

In many places pupils
during their out-of-sch
vacations. Some time
War, many boys and
tain number of Thrif
with which they bou

1. A boy deliver
cash-and-carry trad
the customer and
tion to the 7 ¢, the
One month he ma
Find how much

2. A boy hav
for a grocery st
collecting $13
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3. One su
25 ¢ per rou

PERSONAL CASH ACCOUNT

		FEBRUARY, 1919	RECEIVED	PAID OUT
Feb.	3	Cash on hand	2 60	
	3	Weekly allowance	1 00	
	4	Paid for magazine		15
	5	" " movie ticket		15
	5	" " carfare		10
	7	Deposited in savings bank		3 00
	8	For shoveling snow	50	
		Balance		70
			4 10	4 10
Feb.	10	Cash on hand	70	

The *balance* is the excess of the amount received over the amount paid out.

2. Rule a sheet of paper to show the form of a cash account for two consecutive weeks, balanced each week, and to show the balance item with which the third week should begin: April 7, 1919 (Monday), cash on hand, $1.28, received allowance, $1.00, bought tennis ball, .30¢; Apr. 8, earned 42¢ delivering packages, spent 10¢ for carfare, 10¢ for fruit, 60¢ to get bicycle repaired; Apr. 9, carfare, 10¢; Apr. 10, earned 20¢ for errand, spent 5¢ carfare, bought two 25-cent thrift stamps; Apr. 11, spent 10¢ carfare and 10¢ for ice cream; Apr. 12, earned $1.12 delivering packages and deposited $1 in savings bank. On Apr. 14 received $1 allowance, spent 10¢ carfare, and 20¢ for school lunch; Apr. 16, earned 30¢ for errand, spent 5¢ carfare; Apr. 18, bought catcher's glove, 75¢; Apr. 19, earned 98¢ delivering packages, spent 50¢ for cap, deposited $1 in savings bank.

3. A very common form of cash account is shown below, in which the receipts are entered on the left-hand side of the

account and the payments on the right-hand side. Check the account.

		Receipts				Payments	
1919				1919			
Sept.	1	Cash on hand	3 80	Sept.	1	Magazine	20
		Allowance	50		3	Knife	50
	5	Errands	20			Bicycle repair	40
	6	Delivering packages	1 15		6	Lunch	30
						Balance	4 25
			5 65				5 65
Sept.	8	Balance	4 25				

Rule forms like the one above, make out the cash accounts, and balance them:

4. Receipts: Oct. 4, cash on hand, \$1.85; allowance, 75¢; Oct. 6, errand, 35¢. Payments: Oct. 5, club assessment, 50¢; Oct. 6, tennis balls, 70¢; Oct. 8, railroad fare, 70¢, movies, 15¢.

5. Receipts: Sept. 20, cash on hand, \$2.25; allowance, \$1; Sept. 25, deliveries, \$1.48. Payments: Sept. 22, football pants, \$2.15; Sept. 23, club dues, 25¢; Sept. 25, magazine, 20¢.

6. Rule a form like either that of problem 1 or problem 3 and keep your own personal accounts. Balance the accounts each week. Bring them to class each month for discussion and exchange and check for each other.

3. SCHOOL LUNCHES

School children in selecting their school lunch should select one that is nutritious, varied in character, and easily digested. The amount needed to replace worn-out muscle

tissue, keep the body warm, and furnish energy to do our work has been fairly well established. Pupils of your age need daily from 2400 to 2800 *calories*[1] to supply heat and energy, and about 3 oz. of protein to build up muscle tissue.

1. Wheat bread is 9 % protein and its energy value is 1200 calories per pound. When bread is cut 12 slices per pound loaf, how much protein and how many calories is one getting per slice?

2. A "pat" of butter ($\frac{1}{40}$ lb.) contains 80 calories. A bread-and-butter sandwich (2 slices) and a half-pint of green pea soup containing 130 calories would give a total of how many calories? Would you think that sufficient?

3. Granting that half of your nourishment is gotten from the evening meal and the other two equally divided, how many calories are needed for luncheon on the basis of 2400 calories needed daily?

4. What would you think of the following amount: $\frac{1}{2}$ pt. white bean soup, 110 calories; 2 butter sandwiches, 280 calories each; and rice pudding, 105 calories?

5. Would the following be more or less than needed: baked beans, 170 calories; 2 ham sandwiches, 240 calories each; chocolate pudding, 100 calories?

6. Discuss the following lunch: baked macaroni, 90 calories; vegetable salad, 70 calories; vanilla cake, 30 calories. This was what per cent of the 600 calories needed?

7. What per cent of the amount needed is a pupil getting who takes vegetable soup, 80 calories; egg sandwich, 230 calories; and 2 jelly tarts of 45 calories each?

8. We get most of our protein from meat, eggs, and cheese, yet many vegetables, as beans and peas, are rich in

[1] A *calorie* is the unit of measure used in expressing the energy or fuel value of food.

protein and are therefore good meat substitutes. We need 3 oz. of protein per day. To get it all from round steak, which is 22% protein, how much would we need daily?

9. A lunch counter served $\frac{1}{4}$-pound portions of hamburger steak. When beef is 22% protein and contains 720 calories per pound, find how much of each is in the serve. While this will give the protein needed for a luncheon, how much bread (100 calories per slice) will be needed if no other food is eaten?

10. From the following table make out a varied, well-balanced luncheon giving about 600 calories. (This is about the value of the portions usually served for school lunches. They vary, of course, with the size of the serve.)

Baked beans	170	Cheese sandwich	260
Baked macaroni	90	Apple sauce	100
Potato salad	120	Rice pudding	110
Vegetable salad	70	Bread pudding	130
Butter sandwich	280	Spice cakes	100
Ham sandwich	240	Jelly tarts	80

11. The food value of a glass of milk is about 160 calories. Select, with a glass of milk, a lunch from the above table that gives the required calories.

12. The food value of split pea soup, properly made, is 100 calories per portion of $\frac{1}{2}$ pt. Select, with pea soup, a sufficient school luncheon.

4. THE COST OF SCHOOL INSTRUCTION

The cost of maintaining the public schools of this country — buildings, equipment, teachers' salaries, etc., — is largely met by state and local taxation. So all property owners share in paying for schools, whether they have children in

them or not. The question of cost and attendance should be of interest to all of us.

NOTE. — If further drill is needed in using large numbers before taking these problems, review pages 18 and 19.

1. In 1916 the average daily attendance of the common schools of this country was 15,358,927, and the total cost of the schools that year was $640,717,053. Find the per capita cost based on the average attendance.

SUGGESTION. — You need use but $640,717 ÷ 15,359.

2. In 1916 there was in the common schools a total enrollment of 20,351,687. The average attendance was what per cent of the enrollment?

SUGGESTION. — How many figures will you need to use in getting the result?

3. Estimating the total population as 102,000,000, find the per capita cost of maintaining the schools. That is, find the average cost for each person in the country.

SUGGESTION. — Use but $640.71 ÷ 102. Why?

4. The total school enrollment of New York City in 1916 was 895,512 and the school expenditures were $40,615,323. Find the per capita cost based upon the total enrollment. If the average daily attendance was but 85% of the total enrollment, find the per capita cost based on the average attendance.

SUGGESTION. — Abridge your work as much as possible.

5. Chicago's total school enrollment for 1916 was 360,639, and the total expenditures were $14,078,465. Find the per capita cost based upon the total attendance. This was what per cent of the per capita cost in New York?

6. During the same year St. Louis had a school enrollment of 103,512, and the school expenditures were $4,040,569. Find the per capita cost. Compare the cost with that of New York and of Chicago.

7. Montana with an average daily attendance of 75,241 spent $6,492,588 for schools in 1916. Find the per capita cost.

8. Mississippi during the same year had an average daily attendance of 301,922 and spent $2,806,562. Find the per capita cost. What per cent is this of the cost in Montana?

9. Find the average attendance in your state and the total cost, and find how much it costs for each pupil.

10. Make the same kind of study of the cost in your own town or city, and compare with some of the results found here.

11. The data given here and your answers are interesting and instructive. Write a short paper or give a talk on "The Cost of Public School Instruction," illustrating it by graphs of the numbers that you use.

5. THE "SAFETY FIRST" MOVEMENT

A few years ago was inaugurated a "safety first" campaign that has resulted in a greatly reduced rate of accidents. You will notice signs of warning in street cars, at public crossings, in manufacturing plants, and wherever great danger exists.

1. In 1913, before the "safety first" campaign, there were 54,011 deaths reported as due to accident. In 1915, even with an increase in population, but 51,406 such deaths were reported. Find the per cent of decrease.

2. Deaths due to automobile accidents in 1915 amounted to 3978, and to street-car accidents, 1555. The deaths from street-car accidents were what per cent of those from automobiles?

3. The number of deaths from mine accidents in 1915 was 2009. This was what per cent of those caused by automobile accidents?

4. Legislation restricting the use of fireworks on the Fourth of July and the substitution of more intelligent ways of celebration have greatly reduced the resulting accidents. In 1909 there were 215 deaths due to such accidents and in 1916 there were but 30. Find the per cent of decrease. How many times as many were killed in 1909 as in 1916?

5. In 1908 there were 5460 persons injured in Fourth of July accidents and in 1916 but 820. Find the per cent of decrease. How many times as many were injured in 1908 as in 1916?

6. The number killed by steam railway accidents increased from 8621 in 1915 to 9366 in 1916. Find the per cent of increase.

7. Deaths caused by machinery accidents decreased from 25 per 10,000 of our population in 1907 to 19 per 10,000 in 1915. Find the per cent of decrease.

8. The total accidental deaths decreased from 853 per every 10,000 of our population in 1913 to 763 per every 10,000 in 1915. Find the per cent of decrease.

9. Have traffic laws and a general "safety first" campaign caused any improvement in your city? See if you can find data from which you can give a correct answer.

10. Write an article urging the value of "safety first," using the data and results of these problems. Represent

the data graphically. Offer the best article to your home paper for publication.

6. THE INCREASING COST OF LIVING

During the last few years there has been a rapid increase in the cost of food and clothing. You, no doubt, have heard your parents talk about the "high cost of living" and you have seen such references in the papers and magazines. You should get prices at the time you study this and compare them with the ones given here to see if there is a continued increase or if there is a decrease.

AVERAGE RETAIL PRICES FROM 1913 TO 1917

(From the Federal Bureau of Labor Statistics)

ARTICLE	UNIT	1913	1914	1915	1916	1917
Round steak	pound	$.223	$.233	$ .230	$.250	$.296
Rib roast	pound	.199	.201	.199	.216	.257
Pork chops	pound	.209	.222	.209	.229	.306
Bacon	pound	.270	.267	.264	.284	.416
Ham	pound	.268	.268	.256	.318	.388
Eggs	dozen	.263	.266	.263	.281	.398
Butter	pound	.359	.327	.347	.370	.468
Bread	pound	.050	.055	.064	.062	.085
Flour	½ bbl.	.809	.798	1.110	.959	2.134
Potatoes	peck	.239	.292	.285	.369	.919

1. From the table, find the per cent of increase in the price of round steak from 1916 to 1917. From 1913 to 1917.

2. From the table, find the per cent of increase in the price of flour from 1916 to 1917. From 1914 to 1917.

3. Find the per cent of increase in the cost of bacon from 1916 to 1917. From 1915 to 1917.

4. Select any article in the table in which you are interested and find the rate of increase.

5. Compute the rates of increase as your teacher may direct.

6. Show graphically the relative changes in price of at least one of the articles given in the table.

7. The Bureau of Personal Service of the Board of Estimates of New York City reported that the necessary cost of living for a family of five increased from $844.94 in 1916 to $980.42 in 1917. Find the per cent of increase.

8. In this report (problem 7) the necessary cost of food was given as $383.81 in 1916 and $492.39 in 1917. Find the per cent of increase.

9. In the same report, the cost of clothing was given as $104.20 in 1916 and $120.10 in 1917. Find the per cent of increase.

10. One of the large packing companies reported the following average prices paid per 100 lb. for live stock:

	1915	1916	1917
Cattle	$7.10	$7.21	$ 8.66
Hogs	7.09	8.49	12.89
Sheep and lambs	7.85	9.16	12.79

Find the rate of increase in the price paid for cattle each year over the preceding year. Show the same graphically.

11. Find the rate of increase each year over the preceding in the price paid for hogs. For sheep and lambs.

12. Make a comparison of the cost of pork chops and other items in the table given at the head of these problems at the time you study this, with the price in 1917.

13. The Chicago Daily Drover's Journal reports that from 1907 to 1917 the prices paid per 100 lb. for live stock increased as follows:

	Cattle	Hogs	Sheep	Lambs
1907	$ 5.80	$ 6.10	$ 5.25	$ 7.05
1917	11.60	15.10	11.00	15.10

Compute the per cent of increase in each.

14. Compare the cost of round steak at the time you study this, with the price in 1917; that is, find the per cent of increase or decrease, using the local price, or the average price if you can obtain it.

15. Can you bring from home data from which you can compute the increase or decrease in the cost of living?

16. Work up a talk or a paper upon "The High Cost of Living," showing your number facts graphically. Get any new data you can.

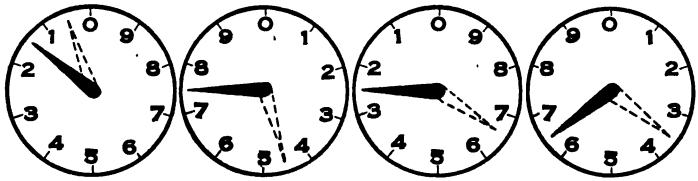
7. THE COST OF ELECTRICITY

The *unit of measure* in measuring electrical energy is the **watt hour.** 1000 watt hours make a **kilowatt hour.** We should be able to read an electric meter, compute the cost of the electricity we are using, and to know the cost of using electric lights and other electrical appliances about the home.

Method of Reading Electric Meter

Each division of the right-hand dial denotes 1 kilowatt hour; the next, 10 kilowatt hours; the next, 100 kilowatt hours; and the left-hand one, 1000 kilowatt hours. Hence, a meter is as easily read as an ordinary number of four

digits. The reading of the following meter is 1726 kilowatt hours.



1. Read the meter with the hands at the dotted positions.

2. If the dotted lines indicate the reading last month and the black lines that of the present month, how many kilowatt hours of electricity have been used?

3. Check the following bill:

March	25	1918	2972 kilowatt hours		
Feb.	20	1918	2935 kilowatt hours		
			37 kilowatt hours @ 10¢	3 70	

4. Find the cost at 10¢ per kilowatt hour: April reading, 1732; May reading, 1761.

5. A family using six 25-watt lights (lamps consuming 25 watts per hour) is using how many watts per hour? What decimal part of a kilowatt? What is the cost at 10¢ per kilowatt?

6. A family that uses, on an average, ten 40-watt lights for 5 hours each evening during the winter months is paying how much per day for light, at 10¢ per kilowatt hour?

7. If the assembly hall in your school uses forty 60-watt lights for 45 minutes each day, what is the daily cost at 10¢ per kilowatt hour?

8. A 6-pound electric iron uses 550 watts per hour. Find the cost per week when the iron is used $5\frac{1}{2}$ hours. (Figure 10¢ per kilowatt.)

9. A vacuum cleaner using 150 watts an hour will cost how much per hour to run?

10. A 12-inch electric fan using 60 watts per hour is used 10 hours per day. Find the cost per month (30 da.).

11. If an electric coffee percolator (450 watts) is used 40 min. per day, and an electric toaster (600 watts) is used 20 min. per day, find the weekly expense for electricity.

12. The carbon filament lights consume $3\frac{1}{3}$ watts hourly per candle power, and the tungsten lamp consumes but $1\frac{1}{4}$ watts per candle power. If a building uses 2400 candle power of light, find the saving per hour by using the tungsten lamps.

13. From data in problem 12, find the per cent of saving. Find also what per cent the cost to light by the tungsten lamp is of the cost of the carbon lamp, if the same amount of light is used in each case. Show the result graphically.

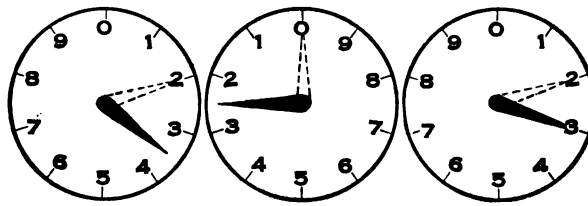
14. Electric motors consume 746 watts of energy per hour for each horse power. If a shop uses a 1-horse-power motor 8 hours daily, what is the cost of the electricity used?

15. Find how many lamps you use daily in your own home, the average number turned on, and compute the cost per hour for electricity.

16. Read daily the electric meter of the school for a short period, and see how much electricity is used daily, and compute the cost.

8. THE COST OF GAS

The price of gas is usually computed on the 1000 cubic feet. The meter records the number of 100 cubic feet. The following diagram shows a reading of 32,300:



1. If the previous reading of the meter was that of the dotted lines, find the cost of the gas consumed at 90¢ per 1000 cu. ft.

Find the cost at 90¢ *per* 1000 *cu. ft.:*

2. Present reading 57,600
   Last reading 34,500
   Gas consumed . . . . . cu. ft. @ 90¢

3. Present reading 77,200
   Last reading 57,600
   Gas consumed . . . . . cu. ft. @ 90¢

4. Present reading 99,200
   Last reading 77,200
   Gas consumed . . . . . cu. ft. @ 90¢

5. The circulating type of hot-water heater consumes from 40 to 100 cu. ft. of gas per hour. At 90¢ per 1000 cu. ft., find the range in cost to run one.

6. Gas heating stoves consume from 15 to 70 cu. ft. of gas per hour. Find the range in cost to run them.

7. In lighting by gas, the cost when using a Welsbach burner runs from $\frac{1}{7}$¢ to $\frac{1}{3}$¢ per hour for a light ranging

from 40 to 90 candle power. Electric light, using the tungsten lamp, consumes $1\frac{1}{4}$ watts per hour for each candle power. At 10¢ per kilowatt for electricity, find the range in cost of electricity to get the same light as from gas.

8. From the results of problem 7, electric light costs about how many times as much as gas?

9. One burner on a kitchen range, turned medium height, consumes 35 cu. ft. per hour. In 12 min. the disk of a fireless cooker can be heated sufficiently to cook a piece of meat requiring 3 hours on the stove. Compute the saving at 90¢ per 1000 cubic feet.

9. BOYS' AND GIRLS' CLUBS IN FOOD PRODUCTION

During the last six or eight years there has been a very rapid growth of the boys' and girls' clubs for the purpose of stimulating the production of food and of conserving it. In 1917 these bands of young people, known as Uncle Sam's Food Army, had a total membership of over 2,000,000.

1. In 1916 there were 985 corn clubs with a total membership of 14,400. Reports were made by 3918 of these. What per cent of the membership made reports of work they had done?

2. The 3918 corn club members reported 9712 acres cultivated and 523,111 bushels of corn produced. Find the average yield per acre, and the average number of acres per member.

3. At $1.75 per bushel, the price in 1917, find the total value of the corn club crop. Find the average amount earned by each member.

4. To produce the above crop, the members invested $142,867.37, including rent of land, members' own labor, and

all other expenses. Find the average investment per member reporting. Find the cost to produce 1 bushel.

5. Find the total net profit. Find the average profit per member reporting.

6. There were 1160 garden and canning clubs in 1916 with a total membership of 24,254. Find the average membership per club.

7. The 7903 canning club members who reported the work they had done had canned 201,305.5 quarts of food. Find the average number of quarts per member reporting.

8. The total production, as reported by the members, cost $28,126.61. Find the average cost per member. Find the average cost of each quart.

9. Estimating the average cost of this if bought at the store, at 28¢ per quart, find the total savings to the homes in which this canning was done.

10. In 1916 there were 1037 pig clubs caring for 5300 animals, producing 728,412 pounds of pork, worth $85,762, at a cost of $42,675 to produce.

(*a*) Find the average weight of each animal.
(*b*) Find the cost to produce 1 pound.
(*c*) Find the average selling price per pound.
(*d*) Find the total net profit to the members.
(*e*) Find the average net profit per animal.
(*f*) The net profit was what per cent of the cost to produce?

11. In Lewiston, Idaho, the members of a "One-tenth Acre Garden Club" demonstrated the possibilities of a $\frac{1}{10}$ acre plot in various types of gardening. The 46 members produced $3864.80 worth of fruit and vegetables one year at a total cost of $724.54 for time, labor, and materials. Find the net profit per member.

12. From the data of problem 11, find the net profit per acre.

13. A girls' canning club put up 846 quarts of tomatoes at a total cost of $96.50. They sold them at 25¢ per quart. How much did they earn?

14. A boy produced $456.25 worth of early vegetables from a plot containing $\frac{5}{8}$ of an acre at a cost of $196.75 and 45 days of time. Find the net value of each day's time spent.

15. A boys' garden club of 30 members produced $1968.30 worth of vegetables one year from vacant city lots at a cost of $270 for seed and fertilizer. Find the average net earning of each member.

16. You, no doubt, have such clubs in your own community. If so, give a paper or a talk upon the activities and successes of the clubs.

17. If you have no clubs in your community, give ways in which boys and girls can help produce and conserve food.

CHAPTER IV

PROBLEMS OF INDUSTRIES OF PUBLIC INTEREST

Arithmetic is studied to give us the power to see, to interpret, and to express the quantitative relationships of the things in which we are interested and that contribute to our welfare and success. To intelligently interpret the various industries upon which our very existence depends, we must use arithmetic to answer many questions that naturally arise about them. This chapter deals with industries indispensable to all of us. Prices, facts, and all kinds of data will have changed when you study this, and so many new and interesting questions will arise from comparing the data given here with those true at the time you take up this work. The data and the results give you valuable information that will furnish material for written articles and talks.

1. PROBLEMS OF THE RAILROADS

We have in this country over 250,000 miles of railroad, representing a total investment of over $17,000,000,000; yet this enormous amount was not enough to meet our actual needs during the years of 1917 and 1918. Our dependence upon the railroads is made very real and clear to us when heavy storms tie up traffic for a few days, causing much suffering in our large cities from want of fuel and food.

1. It is 912 miles from New York to Chicago. The total mileage of all railroads (250,000) would lay how many tracks between these two cities?

2. It is 3191 miles from New York to San Francisco. By how many tracks would our total mileage connect the two great oceans?

3. The total railroad mileage of the world in 1913 was 687,123 miles. America ranked first in amount, having 354,248 miles, and Europe ranked second, having 215,140 miles. Find the rank of these two continents in per cent of the total. (The number of thousands only need to be used.)

THE RELATION OF THE MILEAGE OF AMERICA AND EUROPE TO THE WHOLE IS SHOWN BY THE FOLLOWING GRAPH:

4. Of the 354,248 miles of railroad in America in 1913, the United States had 249,776 miles. The United States had what per cent of the railroads of this continent? Show the relation graphically.

5. A freight engine of the Mallet type costs $37,000. Box cars cost $1500 each, and steel coal cars cost $1200 each. (These were the prices of 1916.) Compute the cost of a train of 25 box cars and 12 coal cars drawn by a Mallet engine.

6. The Pacific type of engine used on passenger trains cost $26,500. Steel day coaches with a capacity of 80 passengers cost $11,000 each, and steel sleeping cars of 24 berths cost $29,000 each. Compute the cost, including the engine, of a passenger train of 4 day coaches and 8 sleepers.

7. Classified under six general heads, the yearly tonnage of freight carried in 1915 was as follows: agricultural products, 109,483,126 tons; animal products, 26,000,428 tons;

mine products, 507,249,821 tons; forest products, 76,674,021 tons; manufacturing products, 130,160,458 tons; miscellaneous, 73,860,591 tons. Arrange these six classes, showing in descending order what per cent each is of the whole. Show by six bar graphs the amounts of each kind of freight.

NOTE. — In problems like this but the nearest number of hundred thousand need to be used. Thus, 1095, 260, 5072, 767, 1302, and 739 will give the same results as you will get by using all.

8. In 1915 there were in use in the United States 1,041,030 box cars with a total carrying capacity of 36,987,000 tons. Find the average carrying capacity of a box car in tons. In pounds.

SUGGESTION. — If you use but 1041 for the divisor, what dividend must you use?

9. During the same year there were 900,780 coal cars with a total carrying capacity of 41,287,823 tons. Find the average carrying capacity of each in tons.

SUGGESTION. — Use but 412.87 ÷ 9. Why?

10. With a total carrying capacity of 41,287,823 tons and the yearly output of coal 569,346,280 tons, how many times a year would each car have to be loaded?

SUGGESTION. — Use 569 and 41.

11. Using the data of problems 5, 8, and 9, find the total investment represented in freight cars.

12. The total revenue in 1915 from both passenger and freight traffic was $2,956,193,202. The total operating expenses were $2,088,682,956. The total investment in roads and equipment was $17,247,101,800. The net profit was what per cent of the investment? (Use the number of figures you think necessary.)

13. The population of the United States in 1915 was estimated at 98,768,000. The railroad investment of

$17,247,101,800 was how much per capita? That is, it represented how much for each person in the United States at that time?

14. The railroad revenue of 1916 averaged $15.701 per mile of line. The operating expenses averaged $10.389. The expenses were what per cent of the income?

15. Excluding the general officers and the division officers, there were 1,626,103 men employed in railroad work in 1916. The total compensation was $1,412,579,190. Find the average yearly compensation.

16. There were 30,091,500 men engaged in all occupations in 1916. Those engaged in railroad work were what per cent of the whole?

17. The gross income of the railroads in 1916 was $3,753,660,000 and in 1917 it was $4,038,000,000. Find the per cent of increase in income.

18. In 1918 there was an increase in freight and passenger rates equal to about 25% of former rates. If the same amount of business is done as in 1917 ($4,038,000,000 worth), this will increase the revenue by how much?

19. It was estimated in 1918 that there would be an increase of $900,000,000 in income and an increase of $620,000,000 in expenses. The increase in expenses was expected to take what per cent of the increase in income?

A Table of Express and Freight Rates

When ordering goods from a distance, one should be able to estimate the cost of delivery in order to know whether it will pay to send away for goods that may be purchased at home. The table given here and the problems that follow will help us in solving such problems as they arise in life.

RATE PER 100 LB. FROM CHICAGO[1]

To	EXPRESS	FREIGHT			
	1st Class Rates	1st Class Rates	2d Class Rates	3d Class Rates	4th Class Rates
Ala.: Birmingham	2.40	1.32	1.12	0.93	0.75
Ari.: Phœnix	8.00	2.90	2.51	2.09	1.75
Ark.: Little Rock	2.65	1.20	1.01	0.77	0.59
Cal.: Los Angeles	8.90	3.40	2.95	2.45	2.07
Col.: Denver	4.20	1.80	1.45	1.10	0.85
Conn.: Hartford	2.55	0.97	0.85	0.65	0.46
Del.: Dover	2.30	0.91	0.80	0.61	0.43
D. C.: Washington	2.25	0.87	0.76	0.57	0.39
Fla.: Jacksonville	3.45	1.30	1.10	0.97	0.85
Ga.: Atlanta	2.60	1.42	1.22	1.03	0.83
Ida.: Boise	7.85	2.81	2.41	2.00	1.65
Ill.: Springfield	1.15	0.39	0.31	0.24	0.20
Ind.: Indianapolis	1.00	0.33	0.28	0.23	0.15
Ia.: Des Moines	1.80	0.60	0.48	0.36	0.27
Kan.: Topeka	2.25	1.00	0.82	0.59	0.43
Ky.: Louisville	1.25	0.43	0.37	0.27	0.19
La.: New Orleans	3.10	1.10	0.90	0.75	0.58
Me.: Bangor	2.95	0.97	0.85	0.65	0.46
Md.: Baltimore	2.25	0.87	0.76	0.57	3.90
Mass.: Boston	2.50	0.97	0.85	0.65	0.46
Mich.: Detroit	1.25	0.39	0.34	0.25	0.17
Minn.: Minneapolis	2.00	0.60	0.50	0.40	0.25
Miss.: Jackson	2.65	1.26	1.06	0.90	0.76
Mo.: St. Louis	1.40	0.46	0.37	0.29	0.23
Mont.: Helena	6.55	2.65	2.26	1.85	1.49
Neb.: Omaha	2.25	0.80	0.65	0.45	0.32
Nev.: Carson City	8.65	3.15	2.76	2.34	2.00
N. H.: Concord	2.55	0.97	0.85	0.65	0.46
N. J.: Trenton	2.40	0.90	0.79	0.60	0.42

[1] These were the prices up to June 25, 1918. Find the express and freight rates at the time you study this, and compare with these.

RATE PER 100 LB. FROM CHICAGO — *Continued*

To	EXPRESS	FREIGHT			
	1st Class Rates	1st Class Rates	2d Class Rates	3d Class Rates	4th Class Rates
N. M.: Santa Fé	4.75	2.20	1.86	1.50	1.25
N. Y.: New York	2.40	0.90	0.79	0.60	0.42
N. C.: Raleigh	2.95	1.17	1.01	0.78	0.56
N. D.: Fargo	2.90	1.17	0.99	0.77	0.54
Ohio: Columbus	1.50	0.43	0.37	0.27	0.19
Okla.: Oklahoma City	3.45	1.50	1.29	1.07	0.87
Ore.: Portland	8.85	3.40	2.95	2.45	2.07
Pa.: Harrisburg	2.15	0.87	0.76	0.57	0.39
R. I.: Providence	2.55	0.97	0.85	0.65	0.46
S. C.: Charleston	3.40	1.30	1.10	0.97	0.85
S. D.: Aberdeen	3.15	1.14	0.95	0.67	0.59
Tenn.: Memphis	2.10	0.85	0.65	0.55	0.43
Texas: Houston	4.10	1.67	1.41	1.16	1.06
Utah: Salt Lake City	6.60	2.65	2.23	1.85	1.49
Vt.: Montpelier	2.50	0.97	0.85	0.65	0.46
Va.: Richmond	2.60	0.87	0.76	0.57	0.39
Wash.: Seattle	8.60	3.40	2.95	2.45	2.07
W. Va.: Charleston	1.85	0.47	0.41	0.31	0.22
Wis.: Madison	1.15	0.39	0.34	0.26	0.18
Wy.: Cheyenne	4.15	1.80	1.45	1.10	0.85

1. Take any city in which you are most interested and find how many times as much you would have to pay for express as for first-class freight.

2. Select a city and find what per cent each class of freight is of the cost of express.

3. Take an average of rates in ten cities and compare the express rates with those of first-class freight.

4. From the same averages, find what per cent each kind of freight is of the average express rates.

5. How much will the freight add to the cost of a phonograph (1st class freight), shipping weight 145 pounds, sent from Chicago to Portland, Oregon? How much will the express charges add to the cost?

6. Reckon the same costs required in problem 5 to your city or to the one nearest you that is given in the tables.

7. How much will the freight add to the cost of a farm wagon (1st class freight) sent from Chicago to Denver, Colorado, shipping weight 1220 pounds? How much to your city or to the one nearest you?

8. The freight on a rowboat or canoe is 4 times first-class freight rates. How much will the freight add to the cost of a rowboat weighing 115 pounds, shipped from Chicago to Montpelier, Vermont? To your city?

9. By how much per can does freight (2d class) add to the cost of No. $2\frac{1}{2}$ canned goods (48 lb. per case of 2 doz.) when shipped in not less than 100 pound lots from Chicago to Seattle? To your city?

10. Find the difference in cost between first-class freight and expressage on a package weighing 150 lb. when shipped from Chicago to Omaha. To your city.

11. The freight on motorcycles is $1\frac{1}{2}$ times the rate on first-class freight. Find the difference between freight and expressage on a motorcycle weighing 380 lb. if sent from Chicago to Richmond, Virginia. To your city.

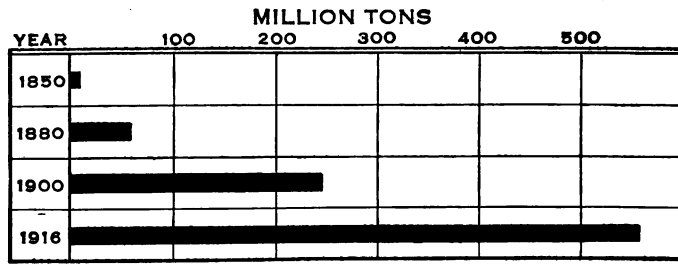
12. If you are interested in ordering goods of any kind from Chicago, find how much the freight or expressage would add to the cost. Then would it pay you to send for the goods instead of buying them in your own city?

2. THE PRODUCTION, DISTRIBUTION, AND CONSUMPTION OF COAL

The coal industry of the United States is one of its most essential industries. We depend almost entirely upon coal to heat our homes, to furnish the power and heat of the factories that prepare much of our food and clothing, and to furnish the power to transport them to us. The shortage of coal for these purposes during the winter of 1917–1918 served to call our attention to our dependence upon it. There are many questions arising in the minds of all of us about our coal supply that we can answer only by arithmetic.

1. The production of coal in this country has grown from 6,266,000 tons in 1850 to 63,823,000 tons in 1880; to 240,789,000 tons in 1900; to 558,505,000 in 1916. Compute the per cent of increase from each date to the next.

Graphically the relations are shown below:



2. The world's estimated production of coal in 1914 was 1,345,322,000 tons, of which the United States ranked first in production, producing 613,525,000 tons; and Great Britain ranked second, producing 297,698,000 tons. Find what per cent of the world's output was mined by each of these two countries.

3. Of the 531,619,500 tons of coal mined in this country in 1915, 442,624,400 tons was bituminous (soft) and the rest anthracite (hard). Find what per cent each is of the whole. Is it necessary to subtract 442,624,400 from 531,619,500 to answer this? How can you check your work?

4. Pennsylvania produces practically all of the anthracite and is also the largest producer of bituminous coal. Of the output of soft coal in 1915, amounting to 531,619,500 tons, the five states leading in production were: Pennsylvania, 157,955,000 tons; West Virginia, 77,184,000 tons; Illinois, 58,829,500 tons; Ohio, 22,434,700 tons; and Kentucky, 21,361,600 tons. Find what per cent of the entire production was produced by each of these states. Find a short way to tell what per cent of the production was produced by all the rest of the states by using the five answers you have found. How could you check the last answer?

Draw a graph showing the relative productions in the five states named.

5. The average price of coal at the mines in 1917 was $1.13 per ton for bituminous and $2.07 for anthracite. Compute the total value of the production of 1915. (See problem 3.)

6. If the 88,995,100 tons of anthracite sold at an average of $2.07 at the mines, and at an average of $7.25 to the consumer, how many dollars did the entire nation pay that year for freight, drayage, profit, etc.?

7. The freight on coal from Scranton, Pa., to Paterson, N. J., in 1917 was $1.45 per ton and the average cost to get it from the car to the consumer was $1.48 per ton. The average retail price of coal that year was $7.25. Trans-

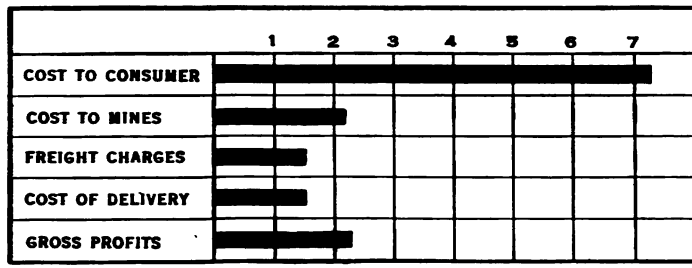
portation and delivery charges were what per cent of the receipts? Investigate the same problem in your own city and find what per cent of the retail price goes to pay freight and delivery.

8. The interesting facts given in problems 6 and 7 may be shown graphically as follows. Study the two graphs given and tell which you like best and why.

THE DIVISION OF THE $7.25 FOR 1 TON OF COAL

GRAPH No. 1

GRAPH No. 2



Make a graph showing costs, freight, drayage, etc., in your own city.

9. A coal dealer in New Jersey, whose total retail business one winter was $12,000, paid out $2885 for freight and $3250 for delivery. What per cent of his sales went for each of these two items? How much did freight and delivery cost one of his customers who used 14 tons at $7.50 per ton? Compare these conditions with those of your own city.

10. Of the grand total of 1,149,842,000 tons of freight carried by the railroads in a recent year, 423,567,000 tons

was coal. What per cent of the freight carried by the railroads was coal?

SUGGESTION. — It is not necessary to use all these figures.

11. The average daily consumption of coal in New York City during the winter months is 45,000 tons. Allowing 100,000 pounds to the average carrying capacity of a coal car, how many carloads per day does New York City use?

12. It is estimated that the household use of coal amounts to 135,000,000 tons per year. How many cars will it take to transport this, allowing 45 tons per car?

13. If more careful attention to stoves and furnaces will reduce the household consumption of coal 15%, how many tons could be saved in this way? Find the value of this saving at $6.50 per ton.

14. The saving of 20,250,000 tons, found in problem 13, would free how many cars, allowing 100,000 pounds per car, for other service? A coal car is filled at the mines about ten times per year. The cost of a coal car is $1200. This household saving would free how much capital for other investments?

15. A coal miner works on an average about 200 days per year and his average daily output is 3.5 tons. The household saving of 20,250,000 tons would free how many men for other employment?

16. On account of a coal shortage in the winter of 1917–1918, the United States fuel commissioner caused certain industries to close down for a few days to allow the production to catch up with the consumption. It was estimated that the saving in coal amounted to $31,500,395. If the average value of each ton saved was $4.75, how many tons were thus saved?

17. To make up a shortage of 50,000,000 tons of coal in 1918, the United States fuel commissioner urged "a shovel a day" campaign in saving. If there are 18,000,000 families using coal in the United States and they can save "a shovel a day" (5 lb.), to what per cent of the shortage will the saving amount in 4 months (120 days)?

18. In 1915 there were 734,000 coal miners employed and they averaged 209 days each in mining 531,619,000 tons of coal. Find the average amount produced each day by a miner.

19. Of the 30,091,500 men engaged in all occupations in 1915, what per cent were working in coal mines, using 734,000 as the total number of miners?

20. There are 127,000 square miles of workable coal mines in the United States. Compare this (in per cent) with the area of Texas, the largest state in the Union, having 265,896 square miles. Compare with Illinois having 56,665 square miles. Find out how many square miles your own state has and compare the total area of the coal mines with the area of your own state.

21. It was estimated in 1913 that there was yet unmined 3,538,506,328,000 tons of coal in this country. At an average yearly consumption of 600,000,000 tons, which is a little more than our present consumption, how long will the supply last?

SUGGESTION. — Use but $35,385 \div 6$. What principle is involved?

22. A certain man earning \$40 per week used yearly 15 tons of hard coal, costing him \$7.50 per ton. What per cent of his yearly income was spent for heat? Compare the cost of heat with the income of families that you know and see whether this per cent of one's earnings for heat alone is large or small.

23. Find from your dealer all the local facts you can about coal and make other problems suggested by these.

24. From data gathered here and from your local dealer, write a paper or give a talk on the subject of "The Production and Distribution of Coal."

3. THE PRODUCTION AND CONSUMPTION OF WHEAT

Wheat is one of our most important and necessary grains. In some form it is used daily by every family in the United States, during normal times, as an article of food. Our average per capita consumption is about 5.3 bushels per year. On account of the shortage in 1918, the United States food commissioner asked every one to have two wheatless days per week. This helped to make more clear to us the necessity of wheat as a food.

Of the wheat-producing countries of the world, we usually rank first and Russia second. During certain years Russia produces more than we do.

1. Of the world's wheat crop of 3,998,756,000 bushels in 1915, we produced 1,011,505,000 bushels and Russia produced 833,965,000 bushels. Find what per cent of the world's crop was produced by each of these two nations. What per cent was produced by all the rest of the world? Solve the last part of this problem in two ways.

2. Our wheat crop of 1917 was but 659,797,000 bushels. Find what per cent of decrease this was from the crop of 1,011,505,000 bushels in 1915.

3. Out of our crop of 659,797,000 bushels in 1917 we were asked to save 240,000,000 bushels for our allies in the great World War. Reserving 125,000,000 bushels for seed, this will reduce our own per capita consumption to how many bushels, considering that our population is 102,000,000?

This is what per cent of our average consumption of 5.3 bu. per capita?

4. A saving of 1 cup of flour ($\frac{1}{4}$ lb.) by each of 22,000,000 families will amount to how much? If this saving is made three times a week, to how much will it amount in a year? Give your answer in barrels (196 lb.). Give your answer in bushels of wheat saved, allowing 4.5 bu. to each barrel of flour.

5. In 1916 we planted 50,871,000 acres in wheat and harvested 607,557,000 bushels. Find the average yield per acre.

6. It is estimated that better seed and better fertilization could easily increase the average yield of wheat to 25 bushels per acre. Such a yield in 1916 would have given us a crop of how many bushels?

7. In 1918 the government fixed the price of wheat at $2.20 per bushel for the year. An average yield of 11.9 bushels per acre will give an income of how much per acre? An average of 25 bushels would increase the income per acre by how much?

8. An experiment station produced 28.18 bu. from an acre at the following cost: rent, $8; plowing, $2; dragging and seeding, $1; seed, $3.85; harvesting, $1.50; threshing and hauling to market, $4.66. Find the cost to produce one bushel.

9. At $2.20 per bushel, the yield and cost to produce given in problem 8, would give a net profit of how much per acre?

10. One year Kansas planted 8,500,000 acres in wheat. At the net profit found in problem 9, how much would the wheat crop have increased the wealth of the state?

11. Kansas leads as a wheat-producing state. In 1916 she produced 89,742,000 bushels. At a per capita consumption of 5.3 bushels, her crop that year would have supplied what per cent of the population of the nation? (Use 100,000,000 as the population in 1916.)

12. If Kansas produced her crop of 1917 at a cost of 75¢ per bushel and sold it at an average price of $1.80, by how much was her wealth increased?

13. If we each consume 5.3 bu. of wheat yearly, what is the cost of it at $2.20, the price fixed for 1918?

14. Our consumption for each person, if made into flour, would be 1.17 bbl. At $17.25 per barrel, find the cost. This is how much more than the cost of the wheat from which the flour was made? How do you account for the difference?

15. Wheat produces 72% of its weight in flour. Using 196 lb. to the barrel, see if the consumption given in problem 14 is correct. (1 bu. of wheat weighs 60 lb.)

16. A pound loaf of wheat bread requires 12 oz. of flour. When a family uses 16 loaves per week, how many pounds of flour are consumed?

17. If a family of 5 buys on an average a sack ($\frac{1}{8}$ bbl.) of flour every three weeks and also buys 16 loaves of bread per week, are they using more or less than the general average? (Use 5.3 bu. as the per capita consumption.)

18. In estimating the production of flour, 4.5 bu. of wheat per barrel of flour is used. From other data found in these problems see how nearly correct this is.

19. It takes 4.5 bu. of wheat to make a barrel of flour. The price of wheat for 1918 was fixed at $2.20 per bushel. If it costs $1.80 to grind and market a barrel of flour, find

the total cost of the grain, the manufacture, and the marketing of a barrel of flour.

20. If flour in 1918 was $17.25 per barrel, how much of this was profit and transportation?

21. We consume 10,000,000 barrels of flour per month. Based upon the conditions found in problems 19 and 20, what does profit and transportation cost the nation each month?

22. Find the price of wheat and flour at the time you study this and find how much more your mother is paying for flour than the cost to produce it, allowing $1.80 as the cost to grind and market a barrel of flour.

23. If we exported 240,000,000 bushels of wheat in 1918, calculate the number of carloads, allowing an average capacity of 80,000 pounds per car.

24. Allowing the average carrying capacity of a ship to be 1600 tons, how many shiploads would such an exportation make? If this is transported in 6 months (180 days), how many ships must leave our ports daily loaded with wheat?

25. In making a loaf of "war bread," some use 3 oz. of flour substitute with 9 oz. of flour. What per cent is thus saved? Such a saving by every one in all uses made of flour would be a saving of how many barrels of flour per year? (Our normal use is 120,000,000 barrels per year.)

26. The saving found in problem 25 would be a saving of how many bushels of wheat? At an average of 15 bu. per acre, the saving would represent the production from how many acres?

4. THE PRODUCTION AND CONSUMPTION OF CORN

The dependence upon corn for meat production and for human food makes it one of our most essential crops. The

average value of the yearly corn crop in this country is about $2,236,000,000. This, however, varies with the production and the market price. The crop of 1917 was the largest ever produced, and sold at a very high price. The increase in price was due partly to the increase in the cost of the factors that enter into the production, some of which are: the increased value of land; the rent or taxes paid; methods of managing; labor; seed; and machinery. Arithmetic can answer many of the problems that arise as we consider the great corn-raising industry.

1. In 1916 there were 108,620,000 acres planted in corn and the yield was 2,717,932,000 bushels. Find the average yield per acre.

SUGGESTION. — Use all the figures, then use 108 as divisor and see how nearly the answers agree. If you use 108 for divisor, what must you use for the dividend?

2. The value of the corn crop of 1916 was $2,236,858,000. Find the average price per bushel.

SUGGESTION. — Experiment as in problem 1.

3. The price of corn in 1917 averaged $1.75 per bushel. This price would have increased the value of the crop of 1916 by how many dollars?

4. Owing to the world's unusual food demands as a result of the great World War, the acreage of 108,620,000 in 1916 was increased 8% in 1917. From this, find the acreage of 1917.

5. The crop of 1917 was 3,124,000,000 bushels. Find the per cent of increase in production and compare it with the rate of increase in acreage. What would your result indicate?

6. The average yield of corn for several years has been 26.8 bushels per acre. It is estimated that greater care in

the selection and testing of seed would easily increase the yield to 50 bushels per acre. This would be an increase of what per cent?

7. If the crop of 3,124,000,000 bushels raised in 1917 could have been increased by this per cent, what would the yield have been?

8. Our average yearly consumption of corn is 2,653,698,000 bushels. This was what per cent of the crop of 1917? Then what per cent of the crop can be exported to other countries?

9. The five states ranking highest in the production of the crop of 1917 were: Illinois, 444,843,000 bu.; Iowa, 411,656,000 bu.; Missouri, 263,463,000 bu.; Nebraska, 232,227,000 bu.; and Indiana, 208,522,000 bu. Find what per cent of the total production each state had. Show these relations graphically.

10. The price of corn, received by the producer, advanced from an average of 82.3¢ per bushel in October, 1916, to $1.751 in October, 1917. Find the per cent of increase.

11. In Iowa, one of our greatest corn-producing states, the cost to produce an acre of corn increased from $16.50 in 1916 to $23.81 in 1917. Find the per cent of increase in the cost to produce it. Which has the greater increase, the price of corn or the cost to produce it? Does this indicate better or worse times for the farmer?

12. In a test crop, 320 pounds of phosphate at $21 per ton were used to fertilize an acre of corn, giving an increase of 11.98 bu. over an adjoining acre that had not been fertilized. With corn worth $1.75 per bushel, how much was made by using the fertilizer? What per cent of the cost of the fertilizer was this?

13. The record "corn-club" yield is 232.7 bushels per acre, raised by a boy in Alabama. How many acres of the country's average yield of 26.8 bushels per acre will it take to produce as much?

14. From an average crop of 2,750,000,000 bushels we export about 5%, use about 8% for human food, and feed the rest to stock. Find the number of bushels used in each of these three items.

15. It is estimated that of the record crop of 3,124,000,000 bushels in 1917, 10% was exported, 20% used for human food, and the rest fed to animals. Find the number of bushels used in each of the three items.

5. THE PRODUCTION AND CONSUMPTION OF COTTON

Over four fifths of the world's entire production of cotton is raised in our Southern states. For example, of the world's entire production of 14,126,500 bales in 1915, all but 2,934,700 bales were produced here. Cloth products from cotton lint are found in every home. From the seed we produce oil, used for human food, and cottonseed meal, used for animal food.

1. In 1916 we ranked first in the production of cotton, producing 11,191,820 bales; and British India ranked second, producing 2,949,600 bales. Find what per cent British India's production was of that of our Southern states.

2. Our cotton crop of 11,191,820 bales raised in 1916 was valued at $627,861,000. Allowing an average of 495 pounds to the bale, find the average price per pound.

3. The price paid the producer in October, 1917, averaged 23.4¢ per pound. At that price find the value of the crop of 5,595,910,000 pounds produced that year.

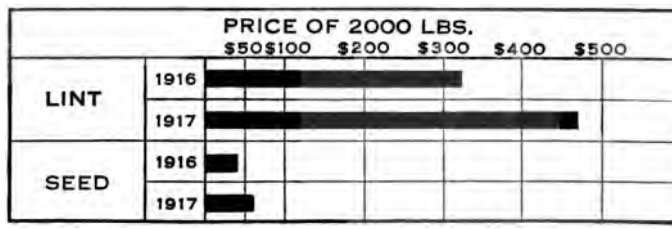
4. In October, 1916, the average price of cotton was but 15.5¢. Find the per cent of increase from October, 1916, to October, 1917 (see problem 3).

5. The cottonseed of the crop of 1916 was estimated at 4,992,000 tons, worth $167,731,200. How much was that per ton?

6. Compare the value of the seed with the value of the lint in the crop of 1916.

7. The price of cottonseed advanced from $47.19 per ton in October, 1916, to $58.12 in October, 1917. Find the per cent of increase. Compare the increase in the price of seed with the increase in price of lint found in problem 4.

8. The following chart shows the value of both seed and lint drawn to the same scale. That is, all are based upon the value of 2000 pounds and drawn upon the same diagram showing $100 spaces.



Compare the value of the seed with the value of the lint in the crop of 1916. The lint of the crop was worth about how many times as much as the seed?

Compare the value of the seed with that of the lint in the crop of 1917.

9. It is estimated that 25% of each year's cotton crop is so exposed to the weather at compresses, on the farms, and

at depots that 12% of its value is lost. Calculate the loss of the crop of 1916.

10. Using data found in these problems, calculate the loss through exposure of the crop of 1917.

11. Of seed cotton, as it comes from the fields, there are about 300 pounds of fiber or lint to 800 pounds of seed. Find the income from an acre that produces 2200 pounds of seed cotton when fiber is worth 23¢ per pound and seed is worth $56 per ton.

12. A grower using 720 pounds of fertilizer per acre, costing him $22 per ton, increased the yield by 520 pounds of seed cotton over the yield of an adjoining field which he did not fertilize. Using the prices of seed and fiber given in problem 11, find how much he made by fertilizing.

13. In August, 1917, we had active 33,430,000 cotton spindles against 32,292,000 of August, 1916. Find the per cent of increase.

14. In 1916 we used in our factories 6,627,000 bales of lint cotton and exported 7,019,000 bales. Find what per cent each was of the total.

15. Of our exports, the most goes to England. In 1916 we sold England 2,985,000 bales. That was what per cent of our total exports?

16. In the number of people employed, our manufacture of cotton goods ranks second. Of the 7,036,000 wage-earners employed in all manufacturing concerns in 1914, 379,000 were employed by manufacturers of cotton goods. This was what per cent of the whole?

17. In 1914 the value of raw material used in the manufacture of cotton goods was $431,602,000 and the value of the goods manufactured was $676,569,000. By what per cent was the value of raw material increased?

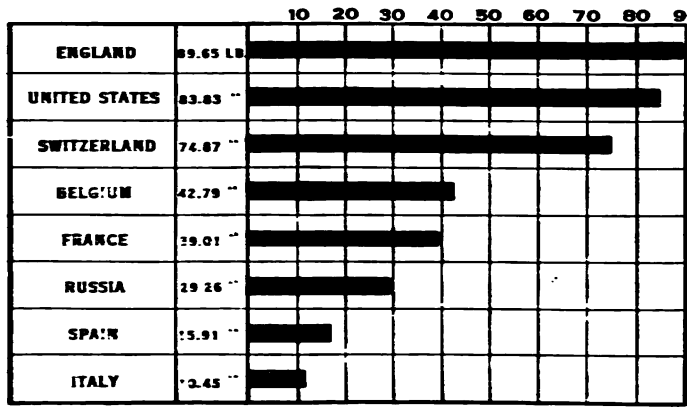
18. It is estimated that the increased use of cotton in 1918 over 1914 was 20% and that the increase in the price of the manufactured articles in 1918 was 45% of their value in 1914. At this estimate, find the total value of the manufactured articles of cotton in 1918.

6. THE PRODUCTION AND CONSUMPTION OF SUGAR

Sugar is a necessary article of food. We should be interested in knowing where it is produced, how much we consume, and whether or not we could produce our own sugar, thus making ourselves independent of other nations.

The per capita consumption of sugar of all kinds in 1915 was estimated to be as follows: France, 39.01 lb.; England, 89.65 lb.; United States, 83.83 lb.; Russia, 29.26 lb.; Italy, 10.45 lb.; Belgium, 42.79 lb.; Switzerland, 74.87 lb.; Spain, 15.91 lb. Thus, it is seen how the consumption varies in different countries.

Shown graphically, the relative per capita consumption is as follows:



1. In 1915 we produced 1,009,425 tons of sugar and consumed 3,801,531 tons. What per cent of our consumption did we produce? What per cent did we have to import?

2. If we were cut off from foreign supplies, how much per capita would our own production give us? Use 2240 pounds per ton and estimate the population at 102,000,000. How would this compare with the per capita consumption of Russia? Of Italy?

3. Of the world's crop of cane sugar in 1916, amounting to 11,173,480 tons, Cuba produced 3,066,000 tons, ranking first. What per cent of the world's crop did she produce?

4. Of the world's crop of 16,685,980 tons of sugar in 1916, 5,512,500 tons was beet sugar. Find what per cent each kind of sugar is of the total.

5. The average retail price of sugar in 1914 was 5.2¢; in 1915, 7¢; in 1916, 8.7¢; and in 1917, 9.1¢. How much has the increase been per year over each preceding year for a family of five that consumes its per capita share of 83.83 pounds? Show the increase graphically.

6. How much has the increase been each year to the nation as a whole, considering that we consume 3,801,530 tons of 2240 pounds each?

7. It is said that New York City consumes 12,500 carloads of candy yearly. Estimating 60,000 pounds per carload and that 85 % of the candy is sugar, how many tons of sugar is used for candy in New York?

8. We were asked during the World War to save sugar. If each family in the United States (estimated at 22,000,000) should save a cup per week (.5 lb.), to how many tons would the saving amount in a year?

9. If the average saving per family of 5 persons is $\frac{1}{2}$ lb. per week, by how many pounds per year will the saving

reduce the per capita consumption? Would we still retain our rank as the second largest consumer of sugar?

10. The per capita consumption of sugar in the United States during 15-year periods has grown from 39.46 lb. in 1885, to 58.91 lb. in 1900, to 83.83 lb. in 1915. Compute the per cent of increase during each period.

11. The daily allowance of sugar to a United States soldier is 3.2 oz. This is what per cent of the per capita consumption of 83.83 lb. yearly?

12. The production of cane sugar in this country has increased from 322,549,000 pounds in 1900 to 621,799,000 pounds in 1917. Find the per cent of increase. At the same rate of increase, what will the production be in 1934?

13. In the production of 646,257 tons of beet sugar in the United States during a recent year, Colorado ranked first, producing 197,137 tons; California second, producing 151,078 tons; and Michigan third, producing 98,714 tons. Rank the production of these three states as per cents of the total. Show their relative productions graphically.

14. Many of our states can produce sugar beets at a profit. If our acreage of sugar beets could be made five times as great and improved methods of cultivation could increase the yield 15 %, using the figures of problem 13, how many pounds per capita could we produce, allowing 216,700 tons of cane sugar yearly? (Population, 102,000,000.)

7. THE PRODUCTION AND CONSUMPTION OF POTATOES

The potato is one of the chief food crops of the world. You know how important the potato is to us, yet we do not consume nearly as many per capita as the people of most countries do. Our per capita consumption is but 2.6 bushels

against 9.4 bushels in Belgium, 8.8 bushels in England, and 7.7 bushels in France. It is said that in some localities of the world the per capita consumption reaches 25 bushels per year, or $\frac{1}{2}$ bushel per week.

1. Show graphically the relative consumptions of the United States, Belgium, England, and France.

2. Our average crop of potatoes is about 350,000,000 bushels per year. On account of the world's shortage of food in 1917, we raised 467,000,000 bushels that year. The increase was what per cent of our average crop? Estimating our population to be 102,000,000, how many bushels were available for each person?

3. If we consumed all of our crop of 1917, our per capita consumption will still be what per cent of that of England? Of France? Of our average consumption?

4. Our average yield per acre is 106 bu., while that of England is 240 bu. Compare our yield (in per cent) with that of England.

5. In a recent year Maine raised an average of 210 bushels per acre. Compare this with our average yield. With the average yield of England.

6. Before the World War potatoes could usually be bought of the farmer in Maine for 50¢ per bushel. The freight to places within a distance of 400 miles was about 40¢ per 100 pounds. Find the cost to a family who bought their winter's supply of 15 bu. at 50¢ and paid 40¢ per 100 lb. freight. (1 bu. = 60 lb.)

7. What was the total cost per bushel of the potatoes considered in problem 6?

8. How much did the family save in this way if the potatoes in the local market were $1.75 per bushel?

9. In the production of 1917 (467,000,000 bu.) Michigan ranked first, producing 44,513,000 bu.; New York second, producing 43,500,000 bu.; Wisconsin third, producing 40,306,000 bu.; Minnesota fourth, producing 33,892,000 bu.; and Pennsylvania fifth, producing 32,485,000. Give the per cents of the total produced by each of these five states. Show the relative productions graphically.

10. It is estimated that 25,000,000 bushels of potatoes are thrown away each year as culls. It has been found that when hogs are worth 15¢ per pound, live weight, the culls are worth 80¢ per bushel as feed for hogs. Find the value of the yearly waste of culls.

11. Some of the culls are used in making potato starch. The average price paid for culls for this purpose before the World War was 15¢ per bushel. Find at this price the value of the culls thrown away each year.

12. The culls yield 9 pounds of starch per bushel at a cost of 1¢ per pound to manufacture. The wholesale price of potato starch during the World War was $11\frac{1}{2}$¢ per pound. To make a profit of 20% of the selling price, how much could a manufacturer of starch afford to pay for a bushel of culls? Compare this price with their value as feed for hogs.

13. A "prize patch" of potatoes grown in 1917 yielded 645 bushels of potatoes worth $1.75 per bushel at a total cost of $56 plus 18 days of labor. Find the net amount made for each day of labor.

14. In our best potato-growing sections 165 bushels per acre is considered a "fine crop." Show to hundredths how many acres it would require at this rate to yield as much as the "prize patch" of problem 13.

15. If potatoes are grown in your section, find the average

yield and compare it with some of the yields given in these problems.

16. It is estimated that one fair-sized potato (200 to the bushel) contains as much food as $1\frac{1}{2}$ ounces of flour. In 1917 and 1918 we were urged to eat more potatoes and save flour. If each person (102,000,000 of them) could eat an extra potato daily, how many barrels of flour (196 lb.) would it save in a year? Allowing 4.5 bu. of wheat to a barrel of flour, how many bushels of wheat would it save?

17. An extra consumption of one potato a day by each person for a year would require how many bushels? (Allow 200 potatoes to the bushel.)

18. Would such an extra consumption thus use the surplus production of 117,000,000 bushels in 1917?

19. An extra consumption of a potato a day would increase our average per capita consumption to how many bushels per year? Find the needed data from these problems.

20. It is estimated that 20 % of the potato is lost in peeling it before cooking, and the government urged us to "boil with peelings on" during 1918. Find the loss in peeling the crop of 1917, valued at $575,000,000.

8. PROBLEMS OF THE CATTLE INDUSTRY

Our dependence upon the cattle-raising industry for milk, butter, cheese, beef, hides, and tallow causes many problems to arise that arithmetic can solve for us. The great grazing ranches of the West having been divided up into cultivated farms, cheap pasture is no longer found for cattle, hence, the price of cattle has rapidly advanced for several years.

1. In 1900 the number of cattle in the United States was 43,902,414. In 1916 the number was 60,715,000. Find the per cent of increase during the sixteen years.

2. The population of the United States increased from 75,995,000 in 1900 to 101,883,000 in 1916. Find the per cent of increase. How does the increase in population compare with the increase in the number of cattle? What do the results indicate?

3. In 1910 the number of cattle was 61,803,800, valued at $1,449,528,600. In 1916 the number dropped to 60,715,000 but the value had increased to $2,506,254,000. Find the per cent of the decrease in number and the per cent of increase in value. What would the results indicate as to the price of meat and other cattle products?

4. Find the increase in the average value per head from 1910 to 1916.

5. It is estimated that better breeding would increase the value of cattle both for milk and meat purposes by 35% without increasing the cost of production (feed). Such an increase in the value of the cattle of 1916, estimated at $2,506,254,000, would be how much?

6. The average beef consumption in this country in 1915 was 82.7 pounds per capita. Estimating the average dressed weight of cattle to be 616 pounds, find the number of cattle needed each year for beef.

7. Our annual consumption of milk is about 2,320,000,000 gallons. If a cow averages 540 gallons per year, how many cows are needed yearly to produce the milk used?

8. From the consumption of 2,320,000,000 gallons given in problem 7, find the yearly per capita consumption, considering the population to be 102,000,000. How much would that be daily for each person?

9. A waste of $\frac{1}{2}$ glass ($\frac{1}{4}$ pt.) of milk daily by 22,000,000 families would amount to how many gallons yearly? How

many cows averaging 540 gallons each would it take to supply the waste?

10. We make about 1,532,000,000 pounds of butter yearly. That is how many pounds for each of the 102,000,000 population? When a family of five uses 2 pounds of butter per week, are they using more or less than their average share?

11. The average price paid the producer of butter in 1916 was 27¢ per pound. In 1917 it was 39¢ per pound. Find the per cent of increase.

12. If the average per capita consumption of butter is 15 pounds, find how much the increase of 12¢ per pound in the price of butter added to the cost of one's food for the year.

13. We use an average of about ½ pt. of milk daily. In 1918 the U. S. food commissioner urged us to use (not waste) more milk and less beef. A quart of milk has about the same food value as 9 ounces of round steak. An increase of 50% in our consumption of milk would be equivalent to how many pounds of steak yearly? (Use 102,000,000 pop.)

14. With milk worth 15¢ per quart and steak worth 38¢ per pound, find from the results of problem 13 the difference in cost to the whole nation.

15. Our annual production of cheese is about 320,600,000 pounds, of which 9,400,000 pounds are "home made," that is, made on the farms. Find what per cent is made on the farms. What per cent in factories?

16. A dairyman found that his Jersey cows were each averaging 387 pounds of butter fat per year, worth 30¢ per pound, and at an average cost of $66.50 per head for help and feed. Find the cost to produce 1 pound. Find his net profit from a herd of 48 cows.

17. An experiment showed that young cattle fed on oat straw, corn silage, and cottonseed meal made the same gain as when hay was substituted for the straw, but that the cost in the first case was \$7.75 to get an increase of 100 pounds and in the second case it was \$8.60. How much can a farmer save by using the cheaper feed for 75 cattle that make an average gain of 280 pounds each?

18. A dairyman had a net profit one year of \$1468.50. This was an average profit of \$29.37 from each cow from feeding silage and mixed grain. It is estimated that feeding cottonseed meal would have given him a profit of \$51.75 from each. This would have been a total profit of how much?

19. A careful test in 1916 showed that milk in a large dairy in New England could be produced at 5.53 cents per quart. It was delivered by them to their customers at 14¢ per quart. If the cost of delivery was $2\frac{1}{2}$¢ per quart, find the net profit from a herd of 60 cows that produced an average of 3120 quarts each per year.

20. A dairyman invested \$5000 in a herd of cows. The total yearly income was \$10,848. He paid out \$1500 for help and \$5789 for feed. Allowing 6% interest on the investment, how much net profit did he have for his own time?

9. THE SHEEP-RAISING INDUSTRY

The sheep-raising industry is of interest from both the food and the clothing standpoint. As a food, however, mutton furnishes but about 3.7% of our meat. It is on account of wool entering into so many articles of clothing that the industry is of greatest interest.

1. The number of sheep raised in this country increased from 41,883,000 in 1900 to 52,448,000 in 1910. Find the per cent of increase.

NOTE. — Use only the figures necessary to get tenths of 1 per cent.

2. The number decreased from 52,448,000 in 1910 to 49,162,000 in 1916. Find the per cent of decrease.

3. The value of the sheep in 1910 was $232,841,500 and in 1916, $254,348,000. Find the per cent of increase in value.

4. The 49,162,000 sheep in 1916 produced 288,490,000 pounds of wool. Find the average number of pounds per sheep.

SUGGESTION. — If you use 49 for the divisor, what must you use as dividend?

5. In 1916 the average price of unwashed wool was 29¢ per pound. Find the income per sheep.

6. Of the 288,490,000 pounds of wool in 1916, 244,890,000 pounds was "greasy wool" shorn from live sheep and 43,600,000 pounds was "pulled wool" from the skins of animals slaughtered for mutton. If the wool from live sheep shrinks 59% in the scouring needed to fit it for manufacturing purposes, and the pulled wool shrinks 30%, find the total amount of scoured wool from the production of 1916.

7. The 288,490,000 pounds of unscoured wool of 1916 made 130,755,000 pounds of scoured wool. Find the average per cent of shrinkage. (This includes both the clipped and the pulled wool of 1916.)

8. The crop of washed wool of 1916 was how much per capita for the 102,000,000 people of this country?

9. We used 821,801,000 pounds of wool (unscoured) in 1916 and produced but 288,490,000 pounds of it. What per cent of our consumption did we have to import? What per cent did we produce?

10. It was estimated in 1916 that 65 pounds of scoured wool was needed yearly to equip and maintain a soldier.

About how many soldiers would our own supply furnish should we be cut off from importations?

11. The price of unscoured wool increased from 29¢ per pound in 1916 to 55¢ in 1917. Find the per cent of increase.

12. The price of scoured wool in 1916 was 65¢ per pound. At the same rate of increase as the unscoured wool, what should the price of scoured wool have been in 1917?

13. If labor and all other factors that enter into the cost of producing cloth have increased in the same per cent as wool, what would you expect to find true of all woolen clothing?

14. If each of the 22,000,000 homes of this country uses $1\frac{1}{2}$ pounds of wool yarn yearly for knitting, what per cent of our native wool supply is that? (Use 130,000,000 pounds as our average supply of washed wool.)

15. Our average meat consumption in 1915 was 193.5 pounds for each person. Of this 7 pounds was mutton. What per cent of our meat was mutton?

16. The average dressed weight of a sheep is 42 pounds. How many sheep would it take to supply the mutton consumed yearly? At an average of 8 pounds of unwashed wool each, these would have increased the supply of wool by what per cent? Use data found in these problems.

10. PROBLEMS OF PORK AND PORK PRODUCTS

The scarcity of pork and pork products and the resulting high prices of 1917 and 1918 caused an unusual interest in the questions of the production. The United States Government urged a careful study of the subject and did much to encourage "Boys' Pig-Raising Clubs" throughout the country. Mississippi and Georgia, two states that have high

enrollments in the "pig clubs," increased their production of hogs by over 90,000 in 1917, while the country as a whole showed a decrease of 5,000,000.

1. The estimated number of hogs in this country September 1, 1916, was 65,645,000. On September 1, 1917, the number had decreased to 60,218,000. Find the per cent of decrease. If this decrease continues, what may we expect of future prices?

2. The total number of farms in this country is 6,540,000. If each farm should produce 2 more pigs than at present, by what per cent would it increase the number of 1917?

3. In 1917 there were 45,000 members of "pig clubs." If through their efforts each succeeded in getting 10 more hogs raised, find the value of them at an average of $36 each.

4. A "pig club" member found that for four consecutive months a pig gained 18 pounds, 21 pounds, 27 pounds, and 24 pounds respectively. Find the average daily gain. (Use 122 days.) Represent the relative growths graphically.

5. A boy in one of the "pig clubs" found that his pig made an average daily gain of 2.24 pounds at a cost of 7.3¢ per pound. Find the net profit per day when hogs were selling at 16¢ per pound, live weight. If a farmer could have shown as good a record on a lot of 500 head, what would his daily net gain have been?

6. One boy gave this report: "I began with a pig weighing 58 pounds for which I paid $8.70. In 92 days he weighed 267 pounds and the feed had cost me $9.30. I butchered him and he weighed 227 pounds dressed, and I sold the dressed pork for 25¢ per pound." Find: (*a*) the average daily gain in weight; (*b*) the cost to produce each pound in weight; (*c*) what per cent of its live weight it dressed; (*d*) the net profit.

7. The cost to produce a pound of pork depends upon the feed. When fed largely on corn, it is estimated that to give a profit, the price of hogs, live weight, per 100 pounds, must be 12 times the price of a bushel of corn. With corn $1.75 per bushel, what must the price of hogs be to give a profit? Find if this relation is true of corn and hog prices at the time you study this.

8. It is estimated that an acre of alfalfa pasture will produce an average of 975 pounds of pork, dressed weight. With dressed pork 24¢ per pound, find the value of an acre of alfalfa.

9. One year a Southern farmer received $6450 for his hogs at 15¢ per pound. He estimated that on a pasture of alfalfa and peanuts they had cost him but $3\frac{1}{2}$¢ per pound. Find his net profit. The profit was what per cent of the selling price? Of the cost to produce?

10. During the fall of 1917 a farmer reported that he turned 190 shotes (young hogs) for 6 weeks upon 5 acres of corn with which soy beans had been planted and that the average increase in weight had been 56 pounds each. He marketed the hogs at 16¢ per pound. Find the income per acre.

11. It was estimated that the 5 acres described in problem 10, if planted without beans and gathered, would have yielded 36 bushels of corn per acre, worth $1.35 per bushel. Find the profit from pasturing as described. This was a gain of what per cent over the value as a crop?

12. A farmer estimated that corn with velvet beans was worth $3.25 per bushel when used for feed, while if sold in the market it was worth but $1.20. Find the difference in value of a crop of 3500 bushels. It was worth what per cent more as feed?

13. At an experiment station in one of our Southern states it was found in 1915 that 100 pounds of pork could be produced for $1.96 with corn and soy bean pasture, and for $2.28 with corn and peanut pasture. Hogs that year sold at $7.50 per hundred. Find what per cent of the market value it cost to produce by each method. To a farmer who produced 120,000 pounds of pork per year, find the difference in the cost of production.

14. The per capita consumption of meat in this country in 1915 was 193.5 pounds, of which 103.5 pounds was pork. What per cent of our meat diet was pork?

15. A hog weighing 200 lb. will lose 20 % in dressing. About 20 % of the dressed weight goes into lard. The hams will weigh 12 lb. each, the shoulders 9 lb. each, and the two sides of bacon 10 lb. each. Find how much a 200-lb. hog will dress, how much lard it will produce, what per cent of the dressed weight is ham, what per cent is shoulder, and what per cent is bacon.

16. If there are pig-raising clubs in your community, get data of results and present them to the class for consideration.

11. PROBLEMS OF EGGS AND POULTRY PRODUCTS

One of the industries of the country upon which we depend for food is the raising of poultry and eggs. While we have many small poultry farms throughout the country, our supply comes very largely from the farm barnyard and from small city flocks. In the recent years the best methods of producing poultry and eggs are being carefully studied and poultry farms are increasing in number. In 1918 the United States food commissioner urged every one that could do so to raise poultry to help overcome the meat shortage.

1. In one year from the time a man began raising chickens his books showed the following report:—Receipts: dressed poultry, $4500.83; live chickens, $675.50. Expenses: feed, $1960; eggs for hatching, $480; fuel for incubators, $35; incidental expenses, $42. Find the average monthly profit.

2. One month a boy received 3080 eggs from 125 hens. The feed cost him $21.50 and the eggs brought him 48¢ per dozen. If he spent $1\frac{3}{4}$ hr. per day (30 da.) caring for them, how much did he earn net per hour?

3. A boy kept 40 hens on a city lot. He gave the following record of cost and receipts for 6 months:

Month	No. of Eggs	Price of Eggs	Cost of Feed
November	512	45¢	$7.20
December	488	48¢	7.40
January	820	50¢	7.60
February	804	48¢	7.80
March	844	39¢	7.60
April	772	36¢	7.60

(*a*) Find the average number of eggs laid by each hen.

(*b*) Find the total value of the eggs.

(*c*) Find the average cost to produce a dozen of eggs.

(*d*) Find the net profit from the flock.

(*e*) If he spent an average of $2\frac{1}{2}$ hours daily in caring for the flock, find his net earnings per hour. (Use 180 days.)

4. It is estimated that, on an average, feed for each hen in 1917 cost $1.34 and that the care of each amounted to 30¢. If a flock of hens at this cost average 160 eggs each, find the cost per dozen to produce eggs. At 48¢ per dozen the profit is what per cent of the cost to produce? Of the selling price?

5. On a small poultry farm of 1000 hens a man gathered 8821 dozen eggs in six months, which he sold at an average price of 46 ¢ per dozen. The average cost of feed was $156 per month and the cost to market the eggs was 2 ¢ per dozen. The care of the hens required an average of 4½ hours daily. Deducting $50 as interest on his investment, how much did he make per hour? (Use 180 days.)

12. PROBLEMS OF MANUFACTURING INDUSTRIES

Our dependence upon the manufacturing industries is known to all of us. There is not a thing we use that does not in some way depend upon some manufacturing industry. The magnitude of manufactures is seen when we know that over 7,000,000 wage-earners are employed in manufactures of some type, converting $15,000,000,000 worth of raw material into $25,000,000,000 worth of products.

NOTE. — These problems all involve large numbers. Use only the number of figures necessary to get the answer. By practice you will learn to save much work in computation.

1. In value of the manufactured products, the slaughtering and meat-packing industry ranks first. In 1914 the value of the products was $1,651,965,000. The animals and other material used were worth $1,441,662,000. By how much was the value increased by manufacturing? By what per cent?

2. The number of wage-earners in the packing industry that year was 98,800. The increase in value was how much per wage-earner?

3. The second largest manufacturing industry in 1914 was the iron and steel industry, the value of its products being $918,664,500. The raw material used was worth

$590,825,700. By what per cent was the value increased by manufacturing?

4. The number employed that year in the iron and steel works was 248,716. The increase in value was how much for each person employed?

5. The flour mill products ranked third in 1914, producing $877,679,700 worth from $752,270,000 worth of material by the help of 39,718 wage-earners. Compare in per cent each of these three items with the corresponding items of the packing industry.

6. During a recent year the boot and shoe factories turned out $501,760,000 worth of goods. Compare this with the $676,569,000 worth turned out in the same year by the cotton goods factories.

7. From 1909 to 1914 the number of wage-earners employed in manufacturing concerns increased from 6,615,046 to 7,036,337. Find the per cent of increase.

8. The capital invested increased during the same time from $18,428,270,000 to $22,790,880,000. Find the per cent of increase.

9. Our exports of iron and steel manufactures increased from $225,888,000 in 1915 to $621,209,000 in 1916. Find the per cent of increase.

10. During the year ending June 30, 1916, we exported 21,265 commercial automobiles, valued at $56,805,548. During the year ending June 30, 1917, we shipped 15,977, valued at $42,343,502. Find the per cent of decrease both of the number and of the total value.

11. During the same time our passenger automobiles increased from 56,234, valued at $40,660,263, to 64,808, valued at $48,612,632. Find the rate of increase both of number and value.

13. THE IRON AND STEEL INDUSTRY

The national wealth of a country depends to a large extent upon the iron and steel it has, for without these metals no country can develop great manufacturing industries. The United States now leads all the nations of the world in the production of iron, a large part of which comes from the Superior region.

NOTE. — In solving the problems use only the figures necessary to get the right result.

1. In 1917 we produced 29,916,213 tons of pig iron and 32,151,036 tons of steel. Find what per cent each is of the total. Why is but one division necessary?

2. Our exports of iron and steel manufactures increased from $225,888,358 in 1915 to $621,209,453 in 1916. Find the per cent of increase.

3. In 1915 we produced 55,493,100 tons of iron ore from which 30,384,486 tons of pig iron were obtained. The pig iron was what per cent of the ore?

4. In 1914 the value of the material used in the iron and steel manufactures was $590,825,692 and the value of the manufactured product was $918,664,565. By what per cent was the value of the material increased through manufacture?

5. The total value of the manufactured products of this country in 1914 was $24,246,434,724, of which $918,664,565 was iron and steel products. This was what per cent of the whole?

6. Of the world's product of 72,000,000 tons of pig iron in a recent year, we produced 30,000,000 tons. We produced what per cent of the total?

7. Our total exports of manufactures in 1916 amounted to $2,658,917,000. Of this amount $621,209,450 was from

steel and iron manufactures. Find what per cent of the total this was.

8. A recent three-year average production of iron ore showed the following: United States, 46,300,000 tons; Great Britain, 15,200,000 tons; France, 10,700,000 tons; Spain, 9,500,000 tons; Russia, 5,600,000 tons; all others, 39,600,000 tons. Arrange these in descending order in per cents of the total. Show graphically the relative productions.

9. In making coke for iron blast furnaces it is estimated that 28% of the fuel value of the coal was formerly lost in gas. If $106,575,000 worth of coal is used each year in making coke, find the former loss.

10. If the gas now saved from the coal used in making coke is worth $2.50 for each ton of coke produced, find the value of the gas saved from the coke used in 1916 to blast 55,493,100 tons of ore, allowing 1 ton of coke to 2 tons of ore.

11. The value of the iron ore used in 1915 was $101,288,984 and the value of the pig iron produced from it was $401,409,604. By what per cent was the value increased?

12. There are about 1,268,000 persons in the United States engaged in producing iron and steel and manufacturing it into articles. This is what per cent of all our wage-earners, estimated at 31,000,000?

13. Iron ore is loaded into cars by large shovels capable of filling a 50-ton car in 5 minutes. At this rate, how many cars could be filled in 10 hours?

14. The record of one shovel is 7689 tons per day. Using 50 tons per car, how long a train could this fill, allowing 35 feet as the coupled length of a car?

15. About 28% of manufactured iron and steel is destroyed each year through rust. Find the loss through rust of the factory output of 1914 valued at $918,664,565.

14. FORESTS AND FOREST PRODUCTS

Our very civilization depends upon our forests to such an extent that we could hardly exist without them. We use them for firewood, for lumber and shingles for building, for poles and posts, and for wood pulp, from which the paper is made for our newspapers, books, and magazines.

Our forests now cover over 550,000,000 acres, or about one fourth of the area of the whole country. The present rate of cutting exceeds the annual growth, and all forest products are rapidly increasing in price. We take yearly over 22,000,000,000 cubic feet of wood from our forests, valued at $1,375,000,000.

1. We use 1,860,000 tons of wood pulp yearly in making the paper upon which newspapers and magazines are printed. This is how many tons per day?

2. Given in cords (128 cu. ft.), we used 5,228,000 cords of wood in 1916 for wood pulp. How many cubic feet per day was that?

3. In the winter of 1917–1918 we increased our use of firewood by 5,400,000 cords, in order to save coal. Considering a cord of wood equivalent to $\frac{1}{2}$ ton of coal, find the saving in coal. Reckoning wood at $6.75 per cord and coal at $7.50 per ton, find the total loss to the consumers.

4. The value of the standing timber is called the *stumpage value* of the lumber and is quoted at a price per 1000 board feet of lumber which the logs will produce. 25,000 board feet per acre is a good yield of white pine. When the

stumpage value of Michigan white pine is $18 per 1000, find the value per acre.

5. A 1500-acre forest of white pine was bought in Michigan in 1866 at $1.25 per acre. In 1910 the stumpage value was $17.50 per 1000 bd. ft. With an average yield of 35,000 bd. ft. per acre, find the increase in the value of the forest.

6. The stumpage value of western hemlock in 1912 was $1.75 per 1000 bd. ft. and the average yield was 6,500 bd. ft. per acre. Find the value per acre.

7. In 1910 Washington ranked first in the production of lumber, producing about 4,190,000,000 bd. ft. At an average stumpage value of $3.50 per 1000 bd. ft., find the value of this while yet standing. If the average value when sawed was $18.75 per 1000 bd. ft., find the increased value through manufacture into lumber.

8. The Northern states had originally 150 million acres of forest, of which there still remain standing 90 million acres; the Southern states had 220 million acres, of which 150 million acres remain; the Central states, 280 million acres, of which 130 million remain; the Rocky Mountain section, 110 million acres, of which 100 million remain; and the Pacific slope, 90 million acres, of which 80 million remain. Arrange these, showing in descending order the per cent still standing in each section.

9. Show graphically the facts of problem 8. Make black that part of each graph that shows acreage cut, and shade the part that shows the acreage still standing.

10. The grazing receipts from the national forests increased from $1,210,214 in 1916 to $1,549,794 in 1917. Find the rate of increase.

11. The appropriation for general expenses and improvements in our national forests for 1917 was $5,574,735. The receipts for grazing privileges paid what per cent of the expenses?

12. A single tree of California redwood will make a log for sawing about 85 ft. long and produce about 7500 bd. ft. of lumber. The stumpage value of the lumber is about $6.25 per 1000 bd. ft. From this find the value of a single tree.

13. The largest reported yield per acre of redwood is 2,500,000 bd. ft. At $6.25 per 1000 bd. ft. find the value of the lumber on one acre.

14. Of the yield given above, 40% was lost through breakage due to cutting trees of such enormous sizes. Calculate the money loss.

CHAPTER V

PROBLEMS OF THRIFT AND ECONOMY

Arithmetic should teach us to see the quantitative side of life, particularly that side of it that helps us to answer such questions as: "Will it pay?" or "Which pays better, this or that?" So the questions of thrift and economy deal with the ways of using one's time and money. The following problems are concerned with the value of time as a student and as used in certain activities, and with the use of one's money in buying, as well as with other interesting questions that arithmetic may answer for us.

1. THE MONEY VALUE OF AN EDUCATION

In 1917 the United States Bureau of Education published a bulletin written by A. C. Ellis, entitled "The Money Value of an Education." Many of the problems given here are made from data taken from that bulletin.

1. Uneducated laborers earn an average of $540 per year for 40 years. High school graduates earn an average of $1350 for 40 years. How much more do the high school graduates earn during a period of 40 years?

2. Using the data of problem 1, how much more per year do high school graduates earn? Money loaned at 5 % earns $5 per year on every $100 loaned. How much would have to be loaned at 5 % to earn as much yearly as a high school graduate will earn?

3. Using the result of problem 1, and considering that it takes 12 years of 180 days each to go through the graded school and high school, what was each day's schooling worth? For what wages, then, could you afford to miss a day of school?

4. In another study of a large school system it was found that at 24 years of age boys who had taken the high school course were earning an average of $1350 per year, while those at the same age who had gone to work from the grammar school were earning but $720 per year. This shows that a high school education has the same earning power as what sum of money loaned at 5 %?

SUGGESTION. — Each year the high school graduates earned $630 more than those who went to work from grammar school. Now find how much money it will take to earn $630 per year, when loaned at 5 %.

5. It was shown that in the New York bridge department positions demanding only a grammar school education pay $980 per year, while those demanding a high school education pay $1729. Granting that this difference in salary remains the same for 35 years, how much per year was the 4-year high school course worth? At 180 days per year, how much per day was it worth?

6. Of two boys from the same family, one took one year in a business college after leaving high school and the other took four years in college. At 35 years of age the first boy was earning $1800 and the second $4500. If this is the average difference for 30 years, how much per year was the extra time of 3 years spent in college really worth per year?

7. The Princeton class of 1906 started out with an average salary of $859.60. At the end of five years the average was $2225.80. Find the average yearly per cent of increase.

8. Yale graduates who went out in 1906 showed the following average: First year, $683.85; second year, $898.30; third year, $1257.24; fourth year, $1686.19; fifth year, $2040.04. Find the rate of increase each year in per cent. Show these relations graphically.

9. The following chart is a comparison of the earnings of boys leaving the New York City schools at 14 years of age with those of boys leaving at 18, after taking a high school course.

Weekly Salary	Left at 14	Left at 18	Weekly Salary	Left at 14	Left at 18
When 14 yr. old	$4.00		When 20 yr. old	$ 9.50	$15.00
When 15 yr. old	4.50		When 21 yr. old	9.50	16.00
When 16 yr. old	5.00		When 22 yr. old	11.75	20.00
When 17 yr. old	6.00		When 23 yr. old	11.75	21.00
When 18 yr. old	7.00	10.00	When 24 yr. old	12.00	23.00
When 19 yr. old	8.50	10.75	When 25 yr. old	12.75	31.00

(*a*) Find how much more the boys who remained in school until 18 years of age have earned during the first 25 years of their lives than the others.

(*b*) From 20 to 25 years of age, find what per cent more the high school graduates were earning each year than the others.

(*c*) Compare by per cent the wages of each group year by year from the age of 20 and see whose wages increase more rapidly.

10. An uneducated person soon reaches his maximum earning power. An educated person continues to increase his earning power much longer. The average earnings of lawyers, doctors, and engineers from a large school were as follows: first year, $864; third year, $2016; fifth year,

$2960; tenth year, $3575. Find the average yearly rate of increase in earning power from one period to the next.

2. LARGE ACCUMULATIONS FROM SMALL SAVINGS

Savings that seem insignificant from a single individual make very large amounts when done by all of a city, or state, or nation. This was clearly seen by all of us in the savings of wheat, meat, sugar, etc., during the great World War. The purchase of thrift stamps at the same time made real the same great truth that "Many a mickle makes a muckle."

1. If each of the 22,500,000 school children in the United States could have bought a 25-cent thrift stamp each week, to how much per year would it have amounted?

2. A 5000-ton ship can be built for $800,000. A yearly saving of 25¢ per week from each pupil as found in problem 1 would pay for how many such ships?

3. If this 25-cent saving (problems 1 and 2) would otherwise have been spent for useless things, the total savings would represent the work of how many people making these useless things at an average of $18 per week?

4. If each pupil in the public schools of this country should waste one sheet of paper daily, valued at .2¢, to how much would the waste amount in a school year of 40 weeks (200 days)? This waste will represent the work of how many people at an average yearly wage of $540?

5. If each pupil in the schools of your city or town should waste 5¢ worth of material each week, to how much would it amount in a year of 40 weeks?

6. If each of the 22,000,000 families in this country wasted a glass ($\frac{1}{2}$ pt.) of milk per week, it would represent the milk

from a herd of how many cows giving 15 gallons per week? This herd would represent an investment of how much, counting the average price to be $65 per cow? The feed for such a herd will average 65¢ per cow each week. Find the cost to feed the herd.

7. When the average national waste of meat is 2 oz. per family each day, worth 32¢ per pound, find the value to the nation of such a waste per month of 30 days, considering that there are 22,000,000 families. This represents the wages of how many men earning $75 per month?

8. If each of the 22,500,000 pupils in the public schools eats an average of $\frac{1}{4}$ lb. of candy per week, this will amount to how many carloads per year (52 wk.), allowing 60,000 pounds per car?

9. If each of the 22,500,000 pupils wastes 15¢ per week in food and clothing, how much per year is that? The amount will build how many homes worth $3500 each?

10. It was estimated in 1918 that $\frac{1}{6}$ of the pupils of public schools were able to earn an average of $45 during the summer vacation in garden work and farming. Find to what this would amount. It would represent the yearly earnings of how many laborers getting $525 per year?

11. Of 154 students in the first year of high school in a certain town, 85 earned wages during the summer amounting to a total of $4400. Find what per cent earned money and the average earnings of each.

12. If each of the 102,000,000 persons in the United States should use daily one teaspoonful ($\frac{1}{6}$ oz.) less sugar than usual, how much would the yearly saving to the nation be? At 9¢ per pound, find the value of such a saving.

13. Our yearly per capita consumption of wheat is 5.3 bu. If through using other cereals we can save 30% of this, how many bushels is that for the nation?

14. If to save bread each of us should use one more average sized potato (three per pound) each day, how many bushels (60 lb.) per year would this be for the whole nation?

15. If the saving in wheat (problem 14) amounted to 1 pound per week for each, find the yearly saving in bushels. (60 lb. = 1 bu.)

16. If each pupil in our public schools averages 12 moving picture shows per year at an average cost of 17¢ each, find the total amount spent in this way. That is what per cent of the annual amount of $450,000,000 spent in this way?

17. There are 22,000,000 families in the United States. Find the money loss per year if each family wastes:

(*a*) ½ lb. of meat per week worth 31¢ per pound.
(*b*) 4 oz. of flour per week worth $16.75 per 196-lb. barrel.
(*c*) 1 pt. of milk per week worth 14¢ per quart.
(*d*) 2 oz. of fat per week worth 28¢ per pound.
(*e*) 3 slices of bread per week worth .8¢ per slice.

18. We have 6,362,000 farms in this country. If each could produce one more hog than usual that would dress 185 pounds, how many persons would that supply with our average yearly consumption of 103.5 pounds each?

19. In 1916 we planted 50,871,000 acres of wheat. If by better seed and greater care in cultivating and harvesting, the crop could have been increased 4½ bu. per acre, what would the increase have been?

20. In 1916 we planted 108,620,000 acres of corn. The average yield was but 25 bushels per acre. It is estimated

that the testing of seed would have increased the yield 45%. Find the amount in bushels of such an increase.

21. In 1916 we produced 1,723,135,680 pounds of beet sugar. If better cultivation and improved methods of extracting the sugar could have increased the production 24%, what would the increase have been? How many persons would this have furnished with their average consumption of 83.8 pounds each?

3. ECONOMY IN THE BUYING AND USING OF FOOD

When we realize that the greatest expense of the average family is the cost of their food, and that over $20,000,000,000 is spent yearly in this country for food, we realize the importance of studying the different ways of buying, selecting, and serving it. Arithmetic will greatly aid us in determining some of the economical ways of dealing with these questions.

1. When a No. 1 can of pork and beans weighing 11 oz., net weight, can be bought for 15¢, and a No. 2 can weighing 21 oz. for 20¢, what per cent is saved by buying the larger one if all can be used?

2. When a No. 1 can of fruit can be bought for 20¢ and serves but one meal, and a No. 2 can bought for 28¢ and serves two meals, what per cent is saved by buying the larger can?

3. A family using 225 pounds of bacon yearly found one year that it could be bought at 35¢ per pound "in the piece," 38¢ in small pieces, unsliced, or at 40¢, sliced. Find the total saving of each of the first two prices over the price of sliced bacon.

4. When a glass jar of bacon containing 9 oz., net, costs

38¢ per jar, sliced bacon can be bought for 40¢ per pound. Find the per cent of saving by the cheaper method.

5. A family that uses 15 bushels of potatoes per winter can buy them in $2\frac{1}{2}$ bushel bags at $3.25 per bag, or at 40¢ per peck as needed. Find how much can be saved per year by buying by the bag. Also find the per cent of saving over the price per peck.

6. A family raised and ate, one year, 60 chickens, averaging $4\frac{3}{4}$ lb. each. The cost to raise them was but $7\frac{1}{2}$¢ per pound, while if bought in the market, the cost would have been 28¢ per pound. Find how much was saved and what per cent of the market price was saved.

7. A pound of dried lima beans costing 18¢ has the same food value as 4 No. 2 cans of canned limas costing 16¢ per can. Not considering the cost of fuel in cooking, find what per cent the cost of the canned beans is of the dried ones.

8. A pound of dried apricots costing 24¢ contains 72 pieces (halves), while a No. 2 can of apricots costing 28¢ contains but 16 pieces (halves). By adding 5¢ worth of sugar to the dried ones, each piece has the same food value as a piece of the canned. Find the cost of canned apricots to give the same food value as a pound of dried ones. Also find the saving from using 15 pounds of dried apricots, including sugar, instead of using their equivalent when canned.

9. A quart of milk is equal in value, as supplying energy, to 11 oz. of sirloin steak; to 12 oz. of round steak; to $8\frac{1}{2}$ eggs; or to 10.7 oz. of fowl. Milk at 12¢ per quart is as cheap as these four foods at what price?

10. Using the data of problem 9, find the price of milk in your city and then find at what each of the other four foods should sell in order to furnish as cheap food, and thus determine what kind of food is most economical.

11. From the data in problem 9, eggs at 60¢ per dozen are as cheap as milk at what price?

12. The energy or fuel value of food is measured in calories. The value of a pound of white bread is 1200 calories and of a pound of round steak, 695 calories. It will take how much steak to give the same energy as a pound of bread?

13. A pound of dried beans contains 1565 calories of energy; a can of baked beans (11 oz. net) contains 401 calories. When dried beans are 18¢ per pound and canned beans 16¢ per can, one can buy how many times as much energy from dried beans for a certain sum as from the canned?

SUGGESTION. — 16¢, which buys 401 calories in canned beans, will buy $\frac{1}{4}$ of 1565 calories from dried beans. Why?

14. Lean smoked ham contains 1210 calories per pound, and pork chops contain 1530 calories. Pork chops at 35¢ per pound are as cheap as smoked ham at what price?

15. A quart of milk contains 628 calories of energy and a pound of sirloin steak contains 1100 calories. Milk at 14¢ per quart is as cheap as sirloin steak at what price?

16. A pound of flour contains 1610 calories; and a pound of corn meal, 1620. What can you say of their comparative values as energy-giving foods?

17. It is the protein in our food that builds up muscle tissue. A pound of cottage cheese supplies .209 lb. of protein. A pound of round steak supplies .213 lb. of protein. Then a pound of cottage cheese is worth in protein what part of a pound of steak?

18. A pound of corned beef supplies .156 lb. of protein. Then a pound of cottage cheese is worth how many pounds of corned beef?

19. The body needs 3000 calories of food per day. When corn meal is 8¢ per pound and flour 10¢, find the cost of 3000 calories of each, using data of problem 16.

4. ECONOMY IN CLOTHING

As a people we need to study lessons of thrift and economy along many lines. The luxuries of one generation become the necessities of the next. In the matter of clothing we are becoming more and more extravagant. Our production of millinery alone increased from $9,577,840 in 1880 to $114,160,000 in 1914, or an advance of more than 900 %, while our population in the same time increased but about 75 %. In women's clothing we manufactured $32,000,000 worth in 1880 and $473,888,000 worth in 1914, or an increase of nearly 1400 %.

1. Our national supply of wool is much less than our needs, and our importations are rapidly increasing. For a three-year period before the World War the average importation was $62,457,965 worth yearly. In 1916 it increased to $158,078,251. Find the per cent of increase. Can you suggests ways of saving wool?

2. In leather, too, our needs exceed our own production. The average value of importations of leather before the War was $133,171,398 per year. In 1916 it increased to $177,880,902. Find the per cent of increase. Can you suggest ways of saving leather?

3. Having a $7.50 pair of shoes re-soled at $2.25 will double the wearing period of the shoes and thus save $5.25. Find the per cent saved of the $15 that would have been spent for 2 pairs. If this saving is done by 20,000,000 people yearly, it will amount to how much?

4. The wholesale value of boots and shoes manufactured in this country yearly is $501,760,000. If proper care and repairing will save each of us 25 % of our expenses for shoes, find how much the total will be. The saving would equal the yearly wages of how many laborers each earning $630 per year?

5. Dealers tell us that two pairs of shoes used on alternate days, so as to be kept thoroughly dried out, will last as long as three pairs worn continuously without change. What would the per cent of saving be? This per cent of our yearly factory output is how much?

6. A man can buy an extra pair of trousers to a $30 suit for $7.50 and get as much service as from two $30 suits. What per cent is thus saved?

SUGGESTION. — Consider that $22.50 of the $60 that two suits would cost was saved.

7. A young lady saw a $15 dress which she wanted. But she bought the material and made it herself at the following cost: 6 yd. of goods at 90¢; 2 yd. trimming at 48¢; sundries, 75¢. Find the per cent of saving. Had she paid a woman $3 to help her make it, what would the per cent of saving have been?

8. Stockings selling regularly at 40¢ per pair were sold "special" at $1.98 for a box of six pairs. Find the per cent of saving. That is, the saving was what per cent of the regular cost of $2.40 for six pairs?

9. A woman saw an $8 hat which she wanted, but she bought a frame for 50¢, 2 yd. of velvet at $1.75, and 95¢ worth of trimmings, and made it herself. What per cent of the $8 was saved?

10. A girl priced a no-sleeve velvet jacket and found it cost $20. Instead of buying it, she bought 3 yards of

velvet at $2.25 per yard, 2 yards of silk lining at $1.50 per yard, and paid a woman $1.50 to help her make it. Find the saving. The saving was what per cent of the $20 that the jacket would have cost ready made?

11. A high school girl who had an allowance of $150 per year saved 25% of it by making part of her dresses and suits herself and hiring a woman to help her make the others. Find the saving.

12. A house dress costing $2.50 ready made can be made at home for $1.75. What is the per cent of saving? Such a saving on 4 dresses per year by a woman in each of the 22,000,000 families would be equivalent to the wages of how many people earning yearly $540?

13. A man can have a $3.50 hat cleaned and blocked for $1.50, thus doubling the wearing period. What per cent is thus saved? Suppose 15,000,000 men should thus save by getting a second year's wear out of a hat, how much would be saved every second year?

14. A suit regularly cleaned and pressed will add 25% to its service. Such a saving on $350,000,000 spent yearly for suits is how much?

15. Can you bring to class examples of saving in the use of clothing through proper care, repairing, and making them at home?

5. THE HOME GARDEN

Thrift is not only a matter of saving and of properly using the various products, but it is a matter of production as well. Most cities and towns had their "War Garden Associations" during the World War, and the National Government urged us to make use of all available vacant lots for gardens. But even in times of peace we should continue

to produce as much as possible, for the more there is produced, the more there is for all.

1. It is estimated that the average village, town, and city family spends $138 per year for vegetables. If $\frac{1}{4}$ of the 12,000,000 such families could produce half of what they use by having a home garden, find the total amount thus produced.

2. There are 15,000,000 school children living in towns and cities. It is estimated that one third of these might easily produce $50 worth of vegetables each during the summer vacation. Find the value of such a production.

3. "A million more food gardens" was the cry of the National Emergency Food Garden Commission in 1917. If each garden could produce an average of $250 worth of food, that would be what per cent of our annual expense for vegetables, estimated at $2,850,000,000?

4. In 1916 the pupils of a certain city tilled 13 acres in back yards, producing $3786 worth of vegetables. Find the crop value of each acre.

5. The average per capita cost of vegetables for those living in cities is estimated at $27.50. There were 718 pupils engaged in the production described above. What per cent of their own per capita consumption did they produce?

6. In a town in North Carolina 168 school children tilled 7 acres of back yard gardens, producing $1225 worth of vegetables. Find the profit from each acre and compare it with the profit found in problem 4.

7. Find the average value of a pupil's production and see what per cent of the per capita cost of vegetables it was.

8. A boy sold $18.56 worth of vegetables from a garden 15 ft. by 20 ft. at a total cost of $4.68 for seed and fertilizer.

He spent a total of $23\frac{1}{2}$ hours of time on the garden. Find his net profit for each hour of time.

9. If each of 3,500,000 city boys and girls had produced as much (problem 8), it would have amounted to the yearly wages of how many laborers averaging $650 each?

10. Can you bring to class data of home gardens or school gardens that suggest important problems?

6. GARDENING FOR PROFIT

A small plot of ground near a market for vegetables is often more profitable than large farms devoted to raising grain, hay, and stock. But whether or not such a plot can be made to pay depends largely upon where it is located as to markets.

1. From a home garden a man sold $41.50 worth of telephone peas from a plot 18 feet wide and 121 feet long. At this rate find the income per acre. (1 acre = 43,560 sq. ft.)

2. From one third of an acre of beets interplanted with radishes, a gardener sold $215 worth of radishes and $280 worth of beets at a total expense for production of $138. At this rate find the net profit per acre.

3. From one fourth of an acre of early green onions, followed by spinach, a gardener received $87 from the onions and $63 from the spinach at a cost of $48. Find the net profit per acre.

4. From a ten-acre plot, a gardener gave the following summary one season: Total receipts, $2363; help, $4\frac{1}{2}$ months at $45 per month; seeds, plants, and fertilizer, $280; depreciation in value of tools and shed, $85. How much had he for his own labor?

5. An eight-acre crop of late cabbage yielded 273,000 pounds of cabbage, which sold at $6.80 per ton. The total expense was $321.50. Find the net gain per acre.

6. From $2\frac{1}{2}$ acres of late cabbage a farmer raised 54,000 pounds, which he sold at $8.50 per ton. The total expense was $192.10. Find the net income per acre.

7. From a plot 15 ft. by 50 ft. a gardener raised 690 pounds of onions. At this rate find the income per acre at 80¢ per bushel of 60 pounds.

8. From two fifths of an acre a gardener sold 86 bushels of tomatoes at 45¢ per bushel with an expense of $28. Find the net income per acre at this rate.

9. Try to gather some truck garden data and make problems to be solved by the class.

10. Do you think that it would pay a boy or a girl to raise a garden and sell vegetables in your neighborhood? Can you get data upon which you can justify your answer?

11. Does it pay a family to have a home garden in your neighborhood? Justify your answer by data that you consider reliable.

7. KEEPING HOUSEHOLD ACCOUNTS

Just as a business man keeps strict account of the money he receives and what he pays out, so many thrifty families do the same in regard to their household expenses. In this way they are able to make out a fairly well-balanced budget after a few years' experience, of what per cent of their income should go to various items.

1. The following was furnished by a small family in the Middle West, owning their own home.

	Dr.	Cr.
Salary	$100.00	
Taxes		$ 5.00
Lights		.50
Fuel		10.00
Water		1.75
Food		25.00
Clothes		15.00
Repairs		3.00
Phone		1.25
Education		5.00
Doctor bills		3.00
Recreation		10.00
Balance for saving account		20.50
	100.00	100.00

Without a pencil, tell what per cent of the income was spent for each item.

2. If a man getting $40 per week spends the same per cent for each item, find how much that will allow him for each.

3. The following budget based upon an income of $100 per month was followed by a young married couple:

Rent, including heat		$ 21
Food		30
Operating expenses		
cooking and light	$3.00	
service, laundry	3.00	6
Advancement		
insurance	3.00	
savings	10.00	13
Recreation		8
Clothing		22
Total		$100

At sight tell what per cent each item is of the whole.

4. When a family of five, with an income of $225 per month, spends the same per cent for each item as in the above budget, how much will that be for each item?

5. Can you find what per cent of its income some family is paying for any one of these items, as rent, fuel, food, clothing, etc.?

6. A man in a certain city who earns but $45 per week uses 15 tons of hard coal yearly to heat his house. One year it cost him $8.25 per ton. What per cent of his income did he have to allow for fuel?

7. A man earning $75 per week paid $55 per month for rent. This was what per cent of his yearly income?

8. How do the per cents for fuel and rent found in problems 6 and 7 compare with those of people whom you know?

8. THE VALUE OF GOOD ROADS

In some parts of the country farmers lose a great amount of money on account of bad roads. Good roads not only add to the convenience of country life but save greatly in time and money in getting crops to market.

1. It is estimated that good roads will increase the value of farm land $7.35 per acre. At this rate, what are good roads worth to a farmer who owns a farm of 160 acres?

2. A farmer having a 160-acre farm gave a strip 4 rd. wide and 80 rd. long for a road across it. If the road increased the value of the remaining land $7.35 per acre, how much did the farmer really get per acre for the land he gave for a road? (1 acre = 160 sq. rd.)

3. A farmer living but 5 miles from market can haul two loads of wheat of 40 bushels each per day. He values

his time and team at $6.50 per day. How much per bushel does it cost him to deliver his wheat?

4. On hard macadam road, 70 bushels per load could have been hauled. This would have reduced the delivery (problem 3) to how much per bushel? What would the per cent of saving have been? How much would the saving be on a crop of 3500 bushels?

5. A farmer having a large crop of wheat, and living on a macadam road 5 miles from market, had it hauled on a large motor truck at 7¢ per large bag of $2\frac{1}{2}$ bushels each. Find the cost of delivery per bushel. This price would have saved the farmer (problem 4) how much?

6. The motor truck (problem 5) averaged 52 sacks per load and averaged a load every hour and a half. At this rate, how much would it earn in a 9-hour day?

7. A farmer living on a bad road estimates that the cost each year of delivering his produce is $1000 to deliver $6715 worth of produce. This is what per cent of the value of the produce? With good roads, motor-truck delivery would have cost him but 6% of the value of the produce. What would the saving have been?

8. A farmer has been paying 90¢ per 100 pounds to send calves, lambs, and hogs to the nearest city by express. Now that good roads pass his farm, motor trucks carry them for him at 50¢ per 100 pounds. What is the per cent of saving? How much per year is the saving when he sends an average of 3500 pounds per month?

9. Good roads are enabling the National Government to establish a "Farm-to-table Parcel Post." On a single one-day trip from Lancaster, Penn., to New York City, the postage on butter, eggs, honey, and newly hatched chicks was $31.61. The operating expenses were estimated at 20¢

per mile for the 100-mile trip. Find the yearly profit (313 days) at an average gain equal to this.

10. There are 156,000 miles of improved roads in the United States. It is estimated that a motor truck could make a 100-mile trip and return once every 24 hours. How many trucks would the government need for such a postal service?

11. With 1560 motor trucks in the postal service making a yearly profit equal to that found in problem 9, find the total profit to the National Government.

12. Can you find examples of the money value of good roads in your neighborhood?

9. SELECTING AND TESTING SEED

Experiment shows that selecting and testing seed is one of the greatest factors toward raising a good crop. Tests made through the use of selected seed corn show increases in yield of from four to thirty bushels per acre over adjoining fields planted with untested seed. It is evident to all of us that if a large number of the seed does not germinate or if the quality of the thing grown is poor, a great amount of our labor is lost.

1. If farmers secured their seed corn by selecting the best ears and using the seed from the ears which showed the highest per cent of germination, it is estimated that the present average yield of 27 bushels per acre could be increased to 50 bushels. What per cent of increase would that be?

2. The corn crop of 1917 was 3,124,000,000 bushels. If it had been increased by the per cent found in problem 1, what would have been the value of the increase at $1.75 per bushel, the price paid that year?

3. When planted in hills $3\frac{1}{2}$ ft. apart each way, a farmer gets about 3550 hills of corn per acre and expects to get three stalks to the hill. If this could be done, and each stalk produced an 8-oz. ear, find the yield per acre. (70 lb. of corn in the ear is a bushel.)

4. If untested seed is planted and 30 % of the seed does not germinate, how will the calculated yield of problem 3 be affected?

5. In a boys' corn club, a boy attempted to get a record yield by raising 3600 hills of 4 stalks each per acre, and through careful cultivation and fertilization to get an average of a 14-oz. ear for every stalk. What would such a yield have been?

6. Had he planted untested and unselected seed of which but 75 % germinated and which produced but 12-oz. ears, by how much would it have lessened the yield?

7. What is the per cent of germination when 25 seeds are planted and 16 of them germinate? 20 of them? 23 of them? 12 of them?

Find the per cent of germination:

	No. Planted	No. Germinated		No. Planted	No. Germinated
8.	16	12	**12.**	48	34
9.	28	22	**13.**	32	29
10.	14	13	**14.**	53	47
11.	26	21	**15.**	36	17

10. THE VALUE OF BIRDS TO AGRICULTURE

Our birds are one of the nation's most valuable assets. Without them crop-destroying insects would soon become so numerous as to destroy our crops, and our forests and

trees would be stripped of their foliage. Birds not only destroy the insects but they eat great quantities of weed seed as well. It is the duty, then, of all of us to protect them and help to increase their number.

1. If the loss to the farmer from insects averages 85¢ per acre, what is the loss to the nation, whose estimated acreage in farms is 478,451,000 acres?

2. At an average loss of $1.25 per acre from weeds, find the yearly loss to the nation.

3. Suppose the loss from insects should become 4 times as great (it would ultimately be many times this) and from weeds twice as great if the birds were destroyed, find the yearly value of birds to the nation.

4. The stomachs of 220 red-shouldered hawks, considered a barnyard pest, when examined, showed that but 3 contained remains of poultry while 102 contained mice; 92, insects; and 40, moles, frogs, etc. Find what per cent of the stomachs contained poultry, mice, etc. Do you think the farmer is justified in killing this hawk?

5. It is estimated that a tree sparrow consumes $\frac{1}{4}$ oz. of weed seed daily. How much per year would this be?

6. It is estimated that we have 1,500,000,000 vegetable-consuming birds. Allowing an average consumption of $8\frac{1}{2}$ lb. of weed seed by each, how many acres would this sow at 70 lb. per acre?

7. It is estimated that during certain months the cuckoo consumes daily an average of 175 caterpillars. If this is done for 60 days and the damage of each caterpillar is but .3¢, what is each cuckoo worth?

8. It is estimated that a chickadee will eat 250 insects per day. If but $\frac{1}{20}$ of these are pests, each destroying .2¢

worth per day, how much will 500,000 chickadees be worth daily to a state?

11. RAISING HOGS FOR PROFIT

If properly bred and cared for, the hog is the most profitable farm animal in many sections of our country. Enormous profits are made in some sections of the South where hogs can be raised upon alfalfa pasture and a feed of legumes, as peanuts, soy beans, velvet beans, and cow peas. The "corn belt" of the country, however, has usually been the region producing the most hogs. Whether or not there is profit in hogs depends upon the feed, the breed, and the care given them.

1. The greatest increase in weight for the amount of feed consumed is with a young hog. By trial it was found that beginning with a ten weeks' old pig weighing 38 pounds it took 293 pounds of feed to produce 100 pounds in weight. At a cost of 3¢ per pound for the feed, find the cost per pound to produce meat.

2. When hogs are selling at $16 per 100 lb., find the per cent of profit on the cost to produce the weight described in problem 1.

3. After a hog reached 320 pounds it took 535 pounds of feed to produce the next 100 pounds of weight. With feed at 3¢ per pound and hogs $16 per 100 pounds, find whether the feeding was profitable.

4. On hogs weighing 470 pounds it took 562 pounds of feed to get 100 pounds increase in weight. Find the loss in feeding hogs of this size, using data given above.

5. The cost to produce a pound on hogs weighing from 320 pounds to 420 pounds was what per cent more than to produce a pound on the 38-pound pigs?

6. Another test showed that hogs weighing 75 pounds would increase 100 pounds by using 380 pounds of feed. With feed $2\frac{3}{4}¢$ per pound and hogs \$15 per 100 pounds, will the feeding pay?

7. When corn was but $50¢$ per bushel (56 lb.), find the cost to produce 100 pounds from pigs weighing 75 pounds, supposing that it takes 380 pounds of corn to do this.

8. When corn was \$1.75 (the price in 1918), find the cost to produce 100 pounds of weight on pigs weighing 75 pounds.

9. It is estimated that 12 bu. of corn and \$3 worth of other feed will raise a pig until it is 6 months old. With corn at \$1.75 find the cost to raise a pig six months old.

10. A "scrub" hog will weigh about 125 pounds at 6 months. Would it be profitable to raise such a pig even when hogs are $16¢$ per pound?

11. A well-bred pig will weigh an average of 215 pounds at 6 months. Reckon the profit, using the data of problem 9.

12. When corn was $35¢$ in 1910, hogs were worth $4\frac{1}{2}¢$ per pound. Find whether it was a loss or gain to raise the hogs described in problems 10 and 11.

13. In 1916 a pig could be increased from 50 lb. to 150 lb. for \$2.95 on soy-bean pasture and a daily feed of corn; for \$3.15 on peanut pasture and a daily feed of corn; and for \$3.75 on clover pasture and two daily feeds of corn. Compare the first two costs, in per cent, with the last.

14. In 1916 the price of hogs was \$7.50 per 100 lb. The cost to produce by each method in problem 13 was what per cent of the market price?

15. Using the data found in problems 1–4, find from the price of feed, at the time you study this, at what price it would be profitable in your county or state to raise hogs.

16. Get local data if possible and find what you can about profit in hogs. That is, does hog raising pay in your neighborhood or section of the country? Give data to support your answer.

12. RAISING SHEEP FOR PROFIT

Sheep raising is especially profitable and particularly so at the present time (1918) when the price of both wool and meat is so high. But as in hogs or in any kind of stock raised, the amount of profit depends upon the care given, the feed, and the type of stock.

1. A good breed of sheep will shear 8 lb. of wool and raise a 70-lb. lamb yearly. In Sept., 1917, the farmer received 54¢ per pound for wool and $13.10 per 100 lb. for lambs. At this price what is the yearly profit from each sheep, estimating the feed and care to be $6.75?

2. A "scrub" sheep costing the same to feed would produce but about 4 lb. of wool and a lamb weighing 50 lb. What would be the profit from each sheep? This is what per cent of the profit from a good breed (problem 1)?

3. When a flock of 100 sheep can be kept one year with 15 tons of hay worth $20 per ton, 250 bu. of oats worth 60¢, and $125 for pasture, what is the cost to feed each? The sheep in problem 1 would give a profit of how much per head? Even the "scrub" (problem 2) would give how much profit?

4. To produce meat, the profit comes from feeding young animals. A farmer bought 250 lambs in May, 1917, weighing 48 lb. each, at $12.50 per 100 lb. In October after pasturing them upon 35 acres of pasture, he sold them at $13.10 per 100 lb., they weighing an average of 85 lb. each. The pasture was valued at but $3.50 per acre. Find the net

profit. Considering that the total care given the flock amounted to 15 days, the profit was how much per day?

5. Winter feeding of sheep is expensive, but a farmer bought 400 lambs averaging 89 lb. each in Nov., 1916, at $8.40 per 100 lb. and sold them in March, 1917, at $11.50 per 100 lb., they weighing 116 lb. each. He estimated that each pound of increase cost him 8½¢. Find the net gain. The average time spent in caring for them was 4 hr. per day for 120 days. Did it pay?

6. A farmer used 30 tons of mixed feed one winter for his flock of sheep. The mixture was made from equal quantities of ground corn at $44.10 per ton, wheat bran at $38 per ton, and wheat middlings at $40 per ton. A neighbor with a flock of the same size found that 10 tons of cottonseed meal at $45 per ton had the same food value as the 30 tons of mixture. The cost of the cottonseed meal was what per cent of the cost of the mixture?

7. Try to get data upon the cost to feed sheep in your county or state and the average income from them, and see if sheep raising will pay.

13. PROFIT IN CATTLE

Cattle are raised either to produce beef or to produce milk. So we have two types of cow, the dairy cow and the beef cow. To make money in cattle the farmers select the type for the purpose it is to serve. It never pays to raise "scrub" stock. A "scrub" cow will eat as much and require as much care and stable room as a cow bred for one or the other of the two purposes for which cows are kept.

1. Dairymen often keep an account of the cost of feed, and the income from each cow. In a certain dairy in 1915 one cow cost $49.25 to feed, and she produced 8046 pounds

of milk averaging 4.8% butter fat. Find the cost to produce 1 pound of butter fat.

2. A cow whose feed cost $ 64.30 produced 9370 pounds of milk which averaged 3.7% butter fat worth 36¢ per pound. Allowing $10 for care, was the cow profitable?

3. A cow whose feed cost $54.30 produced 4830 pounds of milk which averaged 4.2% butter fat. With butter fat worth 32¢ per pound, and allowing $12 for the care, was she profitable to keep?

4. A farmer raising his own feed found that the cost to keep a herd of cows at the price for which he could have sold the feed averaged $31 per year for each cow. They averaged 670 gallons of milk each, and each cow raised a calf which sold for $8. If the farmer got 9.2¢ per gallon for the milk, find the net profit from a herd of 24 cows.

5. A man gave the following report of the cost to keep, and the production from, a high-grade Jersey cow:

Received		Paid Out	
640 gal. of milk at 9¢ per qt.		2 tons hay at $12.50 2340 lb. grain at $47 per ton 6 mo. pasture at $2.50 Bedding at $6 My own labor $30	

Find the net profit or loss.

6. A man in Nebraska reported that from a high-grade Holstein cow he got 15,294 pounds of milk that yielded 488 pounds of butter fat for which he received 30¢ per pound. He also sold the skim milk at 30¢ per 100 pounds, receiving $44.42 for it. Find the total income, including a calf worth $12.

7. The cost to keep the cow reported in problem 6 was $61.07 for feed and care. Allowing $17 for interest on the investment and depreciation in value, find the net gain.

8. Allowing 8.59 lb. per gallon, what would the income have been had the milk (problem 6) been sold at 9¢ per quart?

14. THE COST OF WASTEFULNESS

America is called a wasteful nation. With millions of acres of fertile land, vast forests, and rich mines, our needs have been very easily supplied as compared with those of most other nations. But with an increased population to be fed, housed, and clothed, and with a gradual exhausting of the soil and of the timber and mine resources, the resulting high prices are causing us to think of matters of waste. This waste occurs in the household, in storage, in transportation, and on the farms. The following problems give but a slight idea of its extent.

1. The household waste of food is one of our greatest sources of waste. The Department of Agriculture estimates that the annual household waste is $700,000,000 per year. It is estimated that the cost of the necessary food for a family of five in New York City in 1917 was $490. This waste would have fed how many families? This number of families is what per cent of the entire 22,000,000 families in the United States?

2. In a small New England city, the amount of garbage collected decreased from 216 loads averaging 2 tons each in May, 1916, to but 164 loads of the same size in May, 1917. Find the per cent of decrease. Give a reason for the decrease.

3. The garbage collection in Boston was as follows:

	1916	1917	Decrease
March . . .	3606	3033	
April	3275	2827	
May	3231	3008	

Find the per cent of decrease for 1917 over 1916 for each of the three months.

4. In the above table, find the per cent of decrease in the total of 1917 over the total of 1916.

5. During the first four months of 1917, the Health Department of New York City condemned 8,330,896 pounds of food. At this rate, find how much per year this will be.

6. The Health Department of New York City sometimes condemns $50,000 worth of food in a single week. At the estimated yearly cost of food necessary for a family of five (problem 1), such a waste per week would feed how many families?

7. Sometimes careless handling or improper storing will cause the loss of a crop of sweet potatoes. The Department of Agriculture estimates that 20% of the crop of sweet potatoes raised in the Southern states is lost each year through decay. The average crop is about 50,000,000 bushels. Estimate the loss at 95¢ per bushel.

8. It is estimated that 25,000,000 bushels of potatoes are thrown away each year at digging time as culls, and that as many more are thrown away each spring, having become unfit for food. These would have made 9 lb. of potato starch per bushel, worth at wholesale $11\frac{1}{2}$¢ per pound. Find the cost of such a waste.

9. Any home can save the starch from culls and the potatoes that are about to become unfit for food in the

spring by running them through a food grinder and then washing them through several waters, pouring off the water and letting the starch settle on the bottom and collecting it. If 1,000,000 homes, which would have an average of $\frac{1}{2}$ bushel of potatoes that would otherwise go to waste, could get an average of 7 lb. of starch per bushel, worth $12\frac{1}{2}¢$ per pound, what would the total saving be?

10. The waste that occurs on the farms is enormous. The waste of wheat in the harvest fields is estimated at 20,000,000 bushels annually. At $2.20 per bushel (the price in 1918), find the money value of the waste.

11. Estimating 4.5 bu. of wheat to make a barrel of flour, how many barrels of flour would the waste make?

12. It is estimated that 10,000,000 bu. more of wheat is lost from the farm to the mill through leaking wagons and cars. The total waste on farms and in transportation would make how many barrels of flour?

13. We use an average of 1.08 barrels of flour each during the year. How many persons would the yearly waste of wheat furnish with flour?

14. It is estimated that a billion eggs per year are wasted through breakage. At an average price of 34¢ per dozen, find the value of this waste.

15. A record for several months, kept by a number of large packing houses, showed that the loss from breakage averaged 19.22 eggs per case of 30 doz. Find the per cent of loss from breakage.

16. The total loss of eggs from all causes is estimated to be "1 out of every 4." What per cent is that?

17. Gather other data of waste and bring them to class for study.

CHAPTER VI

BUSINESS TERMS, FORMS, AND PROBLEMS

In our daily life we meet certain common business terms and forms that we should be able to interpret. We also meet many simple business problems that we should be able to solve. In a commercial vocation there are many other business problems peculiar to certain kinds of business, but a Course in Mathematics for a Junior High School is not concerned with these. The following topics discuss terms, forms, and problems needed by all in order to interpret things that arise in all walks of life, independent of our chosen vocations.

1. MAKING OUT AND INTERPRETING SALES SLIPS

When buying goods at a retail store a **sales slip** is usually given the buyer, showing what he has bought, what it cost, when it was bought, and whether it was "paid" or "charged." When the goods are paid for, the sales slip usually shows the amount received by the clerk, the total cost, and the amount of change given the customer.

LORD AND TAYLOR
NEW YORK CITY
July 9, 1918

NAME *Mrs. J. S. Barnes,*
ADDRESS *64 Oakwood St.*
SOLD BY *No. 34*
AMOUNT RECEIVED *$15.00*

4 yd.	*silk*	*$1.75*	*$ 7 00*
3 yd.	*satin*	*$1.80*	*5 40*
			12 40
			2 60

1. Study the sales slip shown here and tell when the purchase was made, the amount given the clerk, the amount of change, and any other points of interest.

2. Try to bring to class a sales slip showing a cash purchase and be ready to tell when the goods were bought, what they cost, the amount received by the clerk, and the change given the customer.

3. Try to bring to class a sales slip showing a charged purchase and interpret the words and numbers on it.

4. Pretending that you are the clerk in some local store, make out a sales slip for a cash purchase of groceries.

5. In the same way make out a charge purchase from some local store for dry goods purchased by some member of your class.

6. If you should make a cash purchase for some one, why should you bring back the sales slip with the change?

7. If a purchase is charged, what is the purpose of saving the sales slips until the monthly bill or statement is rendered?

8. A customer bought the following groceries: 1 pk. potatoes, 45 ¢; $1\frac{1}{2}$ lb. butter at 48 ¢; 2 cans of peas at 18 ¢ each; 1 lb. coffee, 32 ¢; 1 doz. eggs, 56 ¢. The payment was made with a five-dollar bill. Make out a sales slip.

9. Mrs. J. J. Harris bought the following articles on a charge account: $2\frac{1}{2}$ yd. silk at $1.80; $5\frac{1}{4}$ yd. velvet at $3.60; 2 spools silk thread at 10 ¢. Make out a sales slip. Use the name of some local store.

10. What change from a twenty-dollar bill should the clerk give back from a sale of $5\frac{1}{2}$ yd. of gingham at 75 ¢; $6\frac{1}{4}$ yd. of organdie at $1.10; $2\frac{1}{2}$ yd. trimming at 60 ¢; $1\frac{1}{2}$ yd. ribbon at 45 ¢?

11. A clerk must be very accurate or he will soon lose his position, yet the purchaser should always check up a purchase to see if it is correct. Mrs. Brown received $1.89 as change

from a five-dollar bill. Find by how much she was overcharged on the following: $4\frac{1}{2}$ lb. roast at 28 ¢; $1\frac{3}{4}$ lb. steak at 36 ¢; $2\frac{1}{2}$ lb. lard at 32 ¢; $\frac{3}{4}$ lb. bacon at 42 ¢.

12. Find the amount of the following purchase: 6 lb. meal at $8\frac{1}{2}$ ¢; 12 lb. flour at 9 ¢; $2\frac{1}{2}$ lb. beans at 18 ¢; $3\frac{1}{2}$ lb. sugar at 9 ¢; $2\frac{1}{2}$ lb. butter at 48 ¢.

13. At local prices find the cost of 2 doz. eggs, $3\frac{1}{2}$ lb. bacon, $6\frac{1}{2}$ lb. rib roast, $1\frac{3}{4}$ lb. round steak.

14. At local prices find the cost of $1\frac{1}{2}$ lb. butter, $2\frac{1}{4}$ lb. lard, 2 cans of tomatoes, $1\frac{1}{2}$ lb. coffee, 8 lb. sugar, and 5 lb. rice and make out a sales slip for a cash payment showing the change from a five-dollar bill.

15. Get local prices of all foodstuffs and make out bills for imaginary purchases.

2. MAKING OUT AND INTERPRETING BILLS OR STATEMENTS

A **bill** or **statement** is more formal than a **sales slip**. When goods are bought on a charge account at a retail store, the items are kept on the books of the store and a monthly bill or statement showing the purchases, credits if any, and the amount due, is usually sent to the customer.

All bills should be paid promptly; that is, within a few days of the time they were rendered. In this way one keeps his credit with the store. We say of one who thus keeps his bills paid promptly that his "credit is good," by which we mean that stores are glad to give him a credit account and let him pay monthly.

1. Study the following bill and tell who bought the goods, from whom, to whom the bill was sent, when sent, and when paid.

HARRIS, ANDERSON & CO.

DES MOINES, IOWA

SOLD TO *Mrs. Robt. T. Holmes,*
67 Northview Ave.,
Des Moines.

MAY 1, 1918.

PURCHASES FOR THE MONTH OF *April, 1918.*

1918	Apr.			ITEMS	TOTAL CHARGES	TOTAL CREDITS	BALANCE
3403	2	4 yd. cambric	$0.25	$1.00			
2516		2 yd. net	.65	1.30			
1810		$2\frac{1}{2}$ yd. crepe	1.85	4.63	$6.93		
8006	4	3 ties	for	2.50			
9136		3 shirts	1.40	4.20	6.70		
1712	11	1 skirt		1.75			
1202		$\frac{5}{8}$ yd. ruffling	for	.32			
1906		$\frac{1}{2}$ yd. ruffling	for	.25	.2.32		
					$15.95		

PAID
May 9, 1918
Harris, Anderson & Co.
E. R. C.

IF CREDIT HAS BEEN OMITTED FOR MERCHANDISE RETURNED, PLEASE INCLOSE CREDIT VOUCHER WITH CHECK FOR DIFFERENCE.

2. Why should one keep a receipted bill?

3. Check the bill shown here; that is, go over the computation and see if it is correct.

4. If you can do so, bring to class several bills or statements and discuss them, showing of whom the goods were bought, when and by whom, and when the bills were paid. Check the bills.

5. Pretending that you are the bookkeeper of some local store, render a monthly bill to some member of the class for goods purchased.

6. Make out a bill from J. B. Fox & Co., Racine, Wis., to Mrs. L. B. Cox for the following purchases: June 10, 1918, 4 pr. hose at 59 ¢; 1 skirt at $7.50; 3½ yd. lace at 90 ¢; 1 dress at $18; on June 17, 1918, 1½ yd. lining at 95 ¢; 2½ yd. silk at $1.80; 1¾ yd. velvet at $3.25.

7. *Check the following bill:*

1918	Aug.			Items	Total Charges	Total Credits	Balance
	2	3 pr. hose	$0.59		$1.77		
	19	1 skirt		$6.00			
		1 waist		2.00			
		1 dress		2.50			
		1 dress		19.00			
		1 suit case		8.50	38.00		
	21	1 dress returned				$2.50	
	27	6 yd. gingham	1.00	6.00			
		1½ yd. banding	.75	1.13			
		1¾ yd. pleating	1.00	1.75	3.88		
					$48.65		$46.15

8. Rule paper and make out a bill for the following, using a made-up name for the store and the name of some pupil as buyer: On March 3, 1918, 3 shirts at $1.25; 2 ties at 85 ¢; 4 pr. socks at 38 ¢; 1 pr. shoes at $5.75. On March 26, 1918, 1 hat, $3; 1 suit, $28. On March 12, 1 shirt returned, $1.25.

9. Playing that you are bookkeeper for a meat market, make out a monthly bill giving as nearly as you can the probable purchases for a family of five.

10. Playing that you are bookkeeper for a large department store, make out a reasonable bill for spring clothing for a family of seven — father, mother, 3 girls in junior and senior high school, and 2 boys in the grades.

3. BUYING AND SELLING AT A DISCOUNT

When goods sell for less than a former price placed upon them, they are selling at a **discount.** Thus, a boy may use his bicycle or canoe for a season and sell it at a *discount* from what it cost him. A retail merchant may give his customers a discount upon goods out of season, or on goods of which he has an over-supply. And sometimes a merchant gives his "cash-and-carry" customers a discount, for he then has no loss from bad debts and no expense for delivery.

1. Frank offered his bicycle to James for $25 to be paid within two months, or for 5 % less if he pays cash. How much will it cost James if he pays cash?

2. At the end of the summer season Sydney bought a canoe that had been selling for $48 but got a 10 % discount. How much did it cost him?

3. A furniture store had a "January sale" in which they gave a 20 % discount from former prices. Find the sale price of the following: a $175 bedroom set; a $125 dining-room set; a $215 living-room set.

4. Find some "special sale" advertised in the daily papers and bring to the class for discussion. Make problems from the data. Can you give a reason for the discount?

5. A certain grocery store gives a 5 % discount to those who pay cash and carry their packages. How much can a woman thus save per year if her average bill is $35 per month without the discount?

6. How much will a customer have to pay in cash for each of the following:

Regular price $35 less 2 % for cash;

Regular price $86 less 5 % for cash;

Regular price $26 less 2½ % for cash?

7. Find upon which class of the following the dealer is giving the largest rate of discount:

Regular price $45, sale price $37.50;

Regular price $68, sale price $57.80;

Regular price $28, sale price $22.40.

8. Find a "special sale" of goods and reckon the rate of discount given on each. Can you give a reason for the different discounts?

9. Make up a problem allowing what you consider a reasonable discount for cash and be ready to tell why it seems reasonable.

10. Make up a problem allowing what you consider a reasonable discount for an out-of-season sale. Do you think that the discounts will be the same upon staple or conservative goods as upon novelties or specialties? Justify your answer.

11. Make up a problem in which a discount is given for goods bought in large quantities and give your reason for the discount allowed.

4. COMMERCIAL OR TRADE DISCOUNT: THE WHOLESALER

You buy goods from the **retail merchant.** He buys from a **wholesale merchant.** It is a custom among certain wholesale dealers to have expensive catalogues containing a **list price** of their goods and then allow their customers (the retail merchants) a *discount* from the list price. The price actually paid for the goods is called the **net price.** Since this discount is given by the wholesaler or manufacturer to the retailer handling his kind of goods, or "to the trade," it is called **trade discount** or **commercial discount.**

1. How much will a retail dealer have to pay a wholesaler for goods listed at \$540, trade discount 20 %?

2. When the catalogue price of goods is \$1250, what is the net price if a 40 % discount is allowed?

3. When the trade discount is $33\frac{1}{3}$ %, how much will a retailer have to pay for goods which the wholesaler lists at \$84.30?

4. If a retailer buys an article listed by the wholesaler at \$25 at a discount of 40 % and sells the article to you for \$20, his profit is what per cent of the price you pay? Of the price he paid? Of the list price?

5. When an article listed at \$48 sells net for \$38.40, what rate of discount has been given? If the buyer retails it at \$45, what per cent of the selling price does he make?

6. Find the net price when the catalogue price is \$27.80 and the rate of discount is 4[illegible] %.

7. When the net price is \$27 for an article listed at \$36, what rate of discount has been allowed? If the buyer retails it at \$35, what per cent of the cost does he make?

Find the net price:

	List Price	Rate of Discount	Net Price		List Price	Rate of Discount	Net Price
8.	$50	25%		**17.**	$175	25%	
9.	85	40%		**18.**	850	20%	
10.	65	33⅓%		**19.**	165	40%	
11.	48	20%		**20.**	134	25%	
12.	150	16⅔%		**21.**	126	33⅓%	
13.	200	25%		**22.**	230	40%	
14.	600	33⅓%		**23.**	360	25%	
15.	450	40%		**24.**	275	20%	
16.	325	20%		**25.**	195	10%	

5. SUCCESSIVE DISCOUNTS: THE WHOLESALER

Usually, when expensive catalogues are made, the list prices remain the same for long periods. When the market changes, new discounts are made. If the market prices increase, a smaller discount is given; but if the prices decrease, the discount is increased. The increase in discount is usually made by stating a new per cent to be applied to the previous *net* price. When two or more discounts are thus applied, they are called **successive discounts.**

1. How much must a retail dealer pay a wholesaler for a bill of hardware, the list price of which is $840, but discounts of 25% and 20% being allowed?

WORK

4)$840
210
5) 630
126
$504

Explanation. — The first discount is $210, leaving $630. 20% of $630 is $126, the second discount, leaving a net price of $504.

2. How much does a customer pay for goods listed at \$8.50 less 20% and 10%?

3. When goods are listed at \$160 less 25% and 10%, what is the net price?

4. At \$360 less $33\frac{1}{3}$% and 20%, what is the net price?

Find the net price:

	List Price	Discounts	Net Price		List Price	Discounts	Net Price
5.	\$17.50	20%, 10%		**11.**	\$16.30	10%, 5%	
6.	24.60	25%, 20%		**12.**	18.75	10%, 10%	
7.	36.50	20%, 10%		**13.**	13.60	20%, 5%	
8.	48.20	25%, 10%		**14.**	14.50	10%, 5%	
9.	28.50	$33\frac{1}{3}$%, 10%		**15.**	16.00	20%, 5%	
10.	32.20	25%, 20%		**16.**	28.40	40%, 10%	

17. Show that \$60 less 40% and 10% is the same as \$60 less 10% and 40%.

18. Show that \$500 less 30% and 20% is the same as \$500 less 20% and 30%.

19. Try other discounts and see if it makes any difference which one is taken first. What is your conclusion?

6. INTERPRETING BILLS OR INVOICES FROM WHOLESALER TO RETAILER

The following forms of bills or invoices sent by wholesalers to retailers show the discounts and **terms of sale.** Sometimes the words "Sold to," as in problem 1, are used; and sometimes "Bought of," as in problem 2, is used. The first form is perhaps the more common.

1. *Check the following invoice:*

CHICAGO, ILL., *May 10, 1919.*

A. G. SPALDING & BROS.,
147 WABASH AVE.

ATHLETIC GOODS

SOLD TO *T. M. Wiley & Sons,*
Des Moines, Iowa.
Terms: *2% 10 days; net 30 days.*

May	*1*	*3 doz. tennis rackets*	*$18.00*	*$54.00*	
		6 doz. tennis balls	*3.25*	*19.50*	*$73.50*
					7.35
			Less 10 %		*$66.15*

2. *Check the following:*

INDIANAPOLIS, IND., *July 15, 1919.*

Mr. B. L. Newton,
Columbus, Ohio.

Bought of CUTHBERTSON & BROS.,
693 PRAIRIE AVE.

CHINA AND GLASSWARE

Terms: *2% 10 days; net 30 days.*

July	*14*	*15 doz. plates*	*$2.80*	*$42.00*	
		18 cov. dishes	*1.65*	*29.70*	*$71.70*
					32.98
			Less 40 %, 10 %		*$38.72*

Make out bills for the following:

3. 3 tennis nets at \$2.25; 4 tennis rackets at \$1.75; 2 doz. tennis balls at \$3.50. Discount 20%.

4. 4 silver forks at \$1.25; 6 spoons at 60¢; 1½ doz. trays at \$24 per dozen. Discounts 20%, 10%.

5. 6 doz. basting spoons at \$1.90; 2 doz. dippers at 75¢; 8 galvanized tubs at 65¢; 14 galvanized buckets at 36¢. Discounts 10%, 10%.

6. 3½ doz. pr. hose at \$9.50; 12½ doz. pr. men's half hose at \$5.40; 8 doz. pr. stockings at \$3.60; 9 doz. pr. cotton socks at \$1.80. Discount 2%.

7. 15 doz. chisels at \$2.25; 4 doz. trays at \$4.50; 6 doz. locks at \$2.40. Discounts 10%, 5%.

7. SELLING ON COMMISSION

The money paid by one person, called the **principal**, to another, called the **agent**, for selling goods of some kind is called **commission**. An agent often gets both a salary and a certain per cent of the money for which the goods sold.

1. Have you ever sold anything on commission? If so, tell the class about it. Did you get a per cent of the amount for which the goods were sold or were you paid so much for each thing sold?

2. If you should solicit subscriptions for a magazine costing \$1.50 per year, what would your commission be on each subscription at 40% of the subscription price?

3. Some agents get a 40% commission for selling books. What would the commission be on a book selling for \$3.50?

4. In some towns, if an agent sells a house and lot for his client, he charges 2½% commission. How much would he get for selling a house and lot for \$9500?

5. Mr. Walker's household furniture and farm implements were sold at a public sale. The auctioneer received $2\frac{1}{2}\%$ commission on the total amount of the sales, which amounted to $1086. How much did he earn?

6. An agent took orders for a grocery firm at $12\frac{1}{2}\%$ of his sales. One month his orders amounted to $1436. How much did he earn? His orders averaged $1020 per month for the year. How much did he make per year?

7. An agent drove through the country taking orders for tea, coffee, and spices at 35% commission. One week his orders amounted to $164.50. His expenses for the week for team and lodgings were $18.35. How much did he make?

8. A real estate agent sold for his client a house, getting for it $6500. Find the agent's fee at $2\frac{1}{2}\%$.

9. For settling an estate a lawyer charged 2% of the amount of money involved in the estate. What would his fee be for settling an estate of $26,500?

10. A salesboy was offered his choice of the following: $8.50 a week; $5 a week and 1% of his sales; or 4% of his sales. He chose the last. His sales averaged $265 per week. How much better than $8.50 was his choice?

11. A salesman got a salary of $2000 and expenses plus 2% of his sales. If he sells $45,000 worth of goods each year, how much does he receive for his work?

12. A salesman in the clothing department of a store got a fixed salary of $1800 per year. His commission averaged 5% of the amount of the sales that he made, which were $36,587. Find his total income from his position.

13. Do you know of salesmen who work on a commission basis? Can you think of any advantages to the salesman of a commission or commission-plus-salary plan over a straight salary plan?

8. BUYING ON COMMISSION

A person is often employed to buy goods for another, receiving a commission upon the amount spent for the goods, or a commission plus a salary.

1. Have you ever known an agent who bought goods for another? If so, do you know for whom and at what commission the goods were bought?

2. An agent bought 500 barrels of apples from a grower at \$1.10 per barrel for his firm in the city. At 3 % what was his commission? Find the total cost to the firm if the freight and drayage was \$27.50.

3. One week an agent bought 9000 bushels of potatoes for his firm at 40¢ per bushel, receiving $2\frac{1}{2}$ % commission for buying. If his traveling expenses were \$26.50, how much did he make?

4. By first reckoning the commission on a bushel in problem 3, see if you can solve it without a pencil.

5. A professional shopper buys clothes for her clients for 5 % commission. One month she bought a total of \$1650 worth for her clients. Her carfare and lunches cost her \$16.10. Find the net amount earned.

6. An agent drove through the country buying hogs, sheep, and calves for a dealer on a 2 % commission. He bought an average of \$14,360 per month at an average net expense of \$65.40 per month. Find his yearly net income for buying.

9. COMMISSION MERCHANTS AND BROKERS

Some who buy and sell on commission are called **commission merchants** and others are called **brokers**. In general, the distinction depends upon whether the goods are actually

handled by the agent or not. If a merchant who sells goods on commission *actually handles* the goods, he is usually called a *commission merchant;* if an agent merely *arranges* for purchase or sales of goods for another, without actually receiving and delivering them, he is usually called a *broker* and his commission is called **brokerage.**

1. A commission merchant in New York sold a consignment of apples for a grower in Colorado for $1350, charging 5 % commission. Find the commission.

2. A commission merchant sold the following produce for a gardener at 5 % commission: 26 crates of strawberries at $3.20 per crate; 1560 bunches of radishes at $3\frac{1}{2}$ ¢ per bunch; 18 baskets of lettuce of 15 pounds each at 14 ¢ per pound, and 8 barrels of spinach at $1.75 per barrel. Find the commission.

3. A commission merchant sold a carload of 1560 melons at 23 ¢ each on a 5 % commission. After paying $42.50 for freight and drayage, how much should he remit the shipper?

4. A truck gardener sent 12 bbl. of spinach and 180 bunches of green onions to a commission merchant to sell on a 5 % commission. The spinach sold at $3.10 per barrel and the onions at 2 ¢ per bunch. Delivery charges were $3.25. How much should the merchant remit to the gardener?

5. A commissioner sold 216 bales of timothy hay averaging 140 lb. per bale at $24 per ton. If the commission was 5 % and the freight $17.50, how much should he remit the shipper?

6. A commission merchant sold 2630 lb. of chicken at 22 ¢ and 73 cases (30 doz. each) of eggs at 38 ¢, upon a 5 % commission. Deducting the commission and $7.85 for freight, how much should he remit?

7. Find the net proceeds from the following shipment sold on a 5 % commission: 45 crates of spring chickens averaging 108 lb. per crate, sold at $22\frac{1}{2}$ ¢; 72 tubs of butter averaging 82 lb. per tub, sold at 37 ¢. Freight $9.65.

8. If you live where gardeners or farmers send produce to a commission merchant, get data and make problems.

10. GENERAL PROBLEMS OF PROFIT AND LOSS

When a man sells an article for more than it cost him, including delivery charges, commission for buying, etc., the difference between the selling price and gross cost is called **the gross profit** or **gain**. If this gross profit is still greater than all expenses of selling, as salaries, commissions, traveling expenses, rent, light, heat, etc., then there is a **net profit** or **gain**. Otherwise there is a **loss**. Whether a business really pays or not depends not only upon selling at a profit but upon the amount of time and labor taken to make the sale.

1. A boy bought butter from a dairy in Vermont and supplied ten families on his street with a total of 26 pounds per week. When the butter cost him 44 ¢ per pound delivered, he charged 48 ¢. How much did he make each week? If the total time taken was $1\frac{1}{2}$ hours per week, how much per hour did he make?

2. A boy received a 30-dozen case of eggs each week from a farmer in the country and supplied families on his street with eggs. He charged his customers 6 ¢ per dozen more than he paid the farmer and the express charges were 55 ¢ per case. Find his profit for one year (52 wk.), allowing a loss of $5.80 for breakage. If the average time spent in delivery, etc., was $2\frac{1}{4}$ hr. per week, how much per hour did he make?

3. A man went into the grocery business with a capital of $4000. At the end of the year he found that he had paid out for goods, including delivery, $9568.50, and that he had received $12,937.85 for them. He paid out $1169.35 for heat, light, rent, telephone, etc., and $60 per month for help. Allowing himself $100 per month as salary, find his profit on the $4000 invested. What per cent did the investment earn?

4. A man received $850 for goods which he sold one month. His gross profit was 25% of his sales, but the expense of selling was $86.50. Find how much he made for his labor.

5. One day a fish market received 600 pounds of cod, for which it paid 5¢ per pound, plus $3.50 for delivery. The cod dressed 500 pounds and was all sold during the day at 11¢ per pound. It took two clerks to dress and sell it. Find the net profit to the market if the clerks were paid $2.75 each.

6. A merchant's sales for the year were $135,684. His gross gain was $28,960. The cost of doing business was $12,685. His net gain was what per cent of his sales?

7. One year a merchant sold $267,385 worth of goods at an average gross gain of 35% of his sales. The expense of doing business was $95,680. Find his loss or net gain.

8. A merchant's sales for the year were $176,874. His gross gain was $56,845. The total expense was $28,675. The net gain was what per cent of the cost of the goods?

9. An ice man pays $5 per ton for ice and $8 more to have it delivered. He sells it at 60¢ per 100 lb., but 20% of every ton is lost by melting. Find the per cent of net gain on the selling price.

10. A grocer bought oranges for $3.50 per box of 156 and sold them at 40¢ per dozen after losing 6 from each box. Find what per cent of the cost was gained.

11. A merchant finds that the general expenses of selling are 13% of the sales. At this rate, what does he reckon as the cost to sell a $5 pair of shoes? A $35 suit? A $2 hat? A $14 suit case?

12. A merchant bought 100 baskets of peaches at 90¢ per basket and sold them at $1.25. By experience he had found that the cost of selling, including delivery, was 18% of the sales. If he lost 10 baskets through decay, did he make or lose, and how much?

13. A dealer bought a carload of apples for $1320, paying a commission of 5% for buying. The transportation charges were $22.75. Some of the apples being damaged, he got but $1150 for them. Find his total loss, not considering the cost to sell them. Find it if the cost of selling was 8% of the sales.

14. What can a man afford to pay for an article that will sell for $25 in order to make 10% net on the selling price if he knows that the cost of selling will be 15% of the sales?

11. THE RETAIL DEALER AND THE CONSUMER

We buy from the **retail dealer**, who in turn buys from the **wholesaler** or **manufacturer**. Those who buy from the retailer goods which they are to use themselves, and not for the purpose of reselling, are called the **consumers**. Those who raise or make the goods are called the **producers**. It is the handling of these productions to get them from the producer to the consumer that constitutes what we call **business**. The cost of getting the product from the producer to the consumer is called the **cost of distribution**.

1. A grocer whose sales amounted to $75,364 one year found that the cost to deliver was $4560. Find what per cent of the sales was paid out for delivery.

2. On a no-delivery basis, what discount could the grocer (problem 1) afford to give?

3. The consumer pays the cost of delivery through an increase in the cost of the goods. If the cost of delivery of a firm which does a business of $186,340 per year is 7% of the sales, how much does it add to what the consumers pay for goods that year?

4. Some towns have a general merchants' delivery that makes deliveries for all the firms of the town, thus reducing the delivery cost nearly one half over the private delivery run by each store. In a town that spends $6,500,000 for groceries, vegetables, meat, etc., the cost of delivery was reduced from 7% to $3\frac{3}{4}$%. Find the total saving.

5. Grocers estimate that the cost of carrying charge accounts and delivery is 12% of their sales. On a "cash-and-carry" basis, for what could they sell articles for which they have charged 35¢? $1.25? 40¢?

6. By such a plan, how much can a housewife save yearly whose bills for the year under the former plan are $635?

7. Some large department stores estimate that the extra cost due to the "returned goods" custom is .3% of their sales. A store that does a yearly business of $2,135,000 estimates that this one expense will be how much per year?

8. A retailer whose yearly sales amounted to $164,560 made a gross gain of 32% of his sales, but the entire cost of doing business was 22% of his sales. Find his net gain.

9. Some large stores find that the cost of doing business is as high as 32% of their sales. At this rate what is the cost of selling a $35 suit?

12. SETTLING INDEBTEDNESS: BANKING

Indebtedness is seldom settled through an actual transfer of money, but settlement is usually made through a written order on some **bank**.

A *bank* is an institution where money is deposited for safe-keeping, and from which it may be withdrawn as wanted; and it is a place where money is loaned.

Opening an Account with a Bank

When you make your first **deposit** with a bank, you will be given a **pass book** in which your deposit is entered to your credit, and a **check book** for writing out orders on the bank to pay out money from your deposit. You will also be asked to write your name on a **signature card**, in order that the signature to orders or **indorsements** may be identified.

DEPOSITED BY
John Doe
IN
THE NATIONAL CITY BANK
OF NEW YORK
Nov. 16 1917

	DOLLARS	CENTS
SPECIE	7	50
BILLS	86	00
CHECKS		
Boston, Mass.	150	00
New York, N.Y.	246	00
Troy, N.Y.	23	00
	512	50

When making a deposit with a bank you will fill out a **deposit slip** similar to the one shown here. This is filled out by the depositor and checked by the teller. It serves as a sort of receipt for the transaction, for, in the future, if any question arises as to the deposit, the deposit slip in your own handwriting and checked by the teller is an unquestionable proof of the transaction.

Making Out a Check

A **check** is an order to some bank to pay out money which you have deposited there. In making out a check, one should seek to protect himself from any dishonest holder of it. Hence, a check should be written in ink. Begin to write the amount as far to the left as possible and to fill the remainder of the space intended for the amount with a heavy line in order that nothing else may be added.

USUAL MANNER OF DRAWING A CHECK

No. 226 Chicago, July 10, 1919

The First National Bank

Pay to the order of A. L. Taylor $165.40

One hundred sixty-five 40/100 Dollars

J. L. Dixon

The words "the order of" make the check **negotiable.** That is, Mr. Taylor, by indorsement, may transfer it to another person for collection. That is, he may write his name across the back and give it to some one else for collection instead of collecting direct from the First National Bank. Before signing his name, he may designate to whom the money is to be paid by writing, "Pay to the order of" the party; then, if lost or stolen, it cannot be collected by the party thus obtaining it. This is called a **restrictive indorsement.**

1. Who is issuing the check shown here?
2. In what bank does Mr. Dixon have a deposit?

3. Who will receive this check?

4. Where and how will Mr. Taylor receive the money named in this check?

5. If Mr. Taylor is living in Peoria, Ill., and doing his banking with the Merchants' Trust Co. of that city, tell the class how and where he will probably get the money named in this check?

6. Can you bring a "paid" check to class and show who gave the check, upon what bank it was drawn, to whom it was made out, the indorsement, where the *payee* (the one to whom the money is payable) received the money, and any other points of interest you can find on it?

7. Pretending that you are paying some member of the class by a check upon some "make-believe" bank, draw up the proper form. Also indorse any such check that you receive from some member of the class and "cash it." Your teacher will act as cashier for all these "make-believe" banks.

8. If one having a balance of $96.40 deposits $150 and $360, and gives checks for $86.30, $17.60, $13.48, $73.60, $125.80, and $6.49, find his balance.

9. A merchant having a balance of $709.30 made the following deposits one month: $93.80, $173.60, $721.40, $563.80, $742.30, and $596.80. He gave the following checks: $1560, $45.30, $175, $5.85, $16.30. Find his balance.

10. A merchant having $2180.36 in a bank deposited $138.40, $216.70, $306.44, $742.20, $139.80, and $632.85, and drew checks for $1700, $312, $847, $216, and $198. What balance did he then have?

Settling Indebtedness by a Draft

When you wish to pay some person at a distance, you can buy a **draft** at any bank and send it instead of sending the money. A draft is only an order of one bank to another bank to pay out money which it has on deposit there. The buyer of a draft will have to pay the bank a small fee for the accommodation in addition to the face of the draft.

USUAL FORM OF BANK DRAFT

The Corn Exchange Banking Co.

No. 2136 Decatur, Ill., July 16 19 19

Pay to the order of J. R. Rice $516.20

five hundred sixteen 20/100 Dollars

To the Merchants' Bank

St. Louis, Mo.

A. J. Ames
Cashier

1. Who is to receive the $516.20 named in this draft?
2. At what bank is the draft bought?
3. Of what bank is Mr. Ames the cashier?
4. To what bank is the order given?
5. Can you give a reason why the buyer of this draft should give the bank a few cents more than $516.20 for it?
6. How can this draft be made over to some one not named in it for collection?

NOTE. — This draft may have been bought by Mr. Rice himself, or it may have been bought by some one not named in it but who wishes to pay Mr. Rice this sum. If bought by Mr. Rice in order to send it to some

one to whom he wishes to pay this sum, he will write across the back "Pay to the order of" the party to whom he wishes to pay the money, and then he will sign his name.

7. If you were going to send a draft to some one in payment of a debt, tell which way you would have it made out and why you would do so.

8. Suppose that you wish to pay Benj. H. Sanborn & Co. of Chicago $25 for books purchased, make out two forms of drafts as to the payee and discuss the advantages of one over the other.

9. Show the indorsements necessary in each case in the drafts you have written.

10. Have you had any experience in paying a debt at a distance without an actual transfer of the money? If so, be able to tell the class about it.

Paying by Post Office Money Order

You can pay small amounts by sending a post office money order which you can buy at your post office. The person to whom you send the money can receive it by giving the money order to the post office where he lives. The sender of the money fills out an application like the following page.

The extra payments above the amount sent are:

For orders from	$ 0.01	to	$ 2.50	3 cents
	2.51	to	5.00	5 cents
	5.01	to	10.00	8 cents
	10.01	to	20.00	10 cents
	20.01	to	30.00	12 cents
	30.01	to	40.00	15 cents
	40.01	to	50.00	18 cents
	50.01	to	60.00	20 cents
	60.01	to	75.00	25 cents
	75.01	to	100.00	30 cents

(Form No. 6001)

Post Office Department No. .....

THIRD ASSISTANT POSTMASTER GENERAL
DIVISION OF MONEY ORDERS

Stamp of Issuing Office

The Postmaster will insert

DOLLARS	CENTS

here .....
the office drawn on, when the office named by the remitter in the body of this application is not a Money Order Office.

Spaces above this line are for the Postmaster's record, to be filled in by him.

Application for Domestic Money Order

Spaces below to be filled in by purchaser, or, if necessary, by another person for him

Amount

six Dollars sixty Cents

Pay to Order of } W. Atlee Burpee & Co.
(Name of person or firm for whom order is intended)

Whose Address is } No. Burpee Building Street

Post Office } Philadelphia

State Pennsylvania

Sent by A. L. Peters.
(Name of Sender)

Address of sender } No. 165 Oakwood Ave. Street

PURCHASER MUST SEND ORDER AND COUPON TO PAYEE

1. What will you have to pay the postmaster for a money order of $25? The fee paid the post office for its work is what per cent of the face of the order?

2. When you send $75 by post office money order the office's fee is what per cent of the amount sent? When you send $100?

3. Compare the cost of sending ten orders of $7.50 each with one for $75.

4. Find the fee charged by some local bank for issuing a $100 draft and compare it with the fee for a postal money order.

5. Can you think of any reason for using a postal money order instead of a draft when sending money?

6. Money can also be sent by an express company money order. If possible, get a blank form of such an order and find the fees charged and compare them with those of the postal money order.

7. Do you see any advantages of either the postal or express money order over the other? Ask the express agent of whom you get the order blank if the company claims any difference in the two methods.

8. You can also send money through a telegraph company money order by paying a fee in addition to the cost of sending the telegram. The one receiving the order collects it through the telegraph company where he receives the order. Can you think of any advantages of sending money in this way?

13. BORROWING MONEY FOR SHORT PERIODS

Men in business often need extra money for a short period in order to meet a payment for goods. Here again the banks are great conveniences, as in the case of paying bills

by checks or drafts drawn upon them. For, if business men are able to offer satisfactory security that the money will be repaid when due, banks will loan them the money needed. Banks charge a certain amount for the accommodation. This charge is called **interest** or **discount**. It is from this that banks earn most of their income. The interest is a certain per cent of the loan for a year's use of it. Thus, \$100 at 6 % means that the borrower pays 6 % of \$100, or \$6, for the use of the money for 1 year, \$3 for 6 months, or \$.50 for 1 month.

1. What is the interest for 1 year of \$200 at 6 %? At 5 %? At 4 %? At $5\frac{1}{2}$ %? At $4\frac{1}{2}$ %?

2. Give the interest of \$1000 at 6 % for 6 months. For 3 months. For 2 months.

3. Find the interest of \$1450 for 3 mo. at $5\frac{1}{2}$ %.

WORK

\$1450
.055
7250
7250
4) 79750
\$19.94

EXPLANATION. — $5\frac{1}{2}$ % of \$1450 gave \$79.75, the interest for 1 year. But $\frac{1}{4}$ of \$79.75 gave \$19.94, the interest for 3 months, or $\frac{1}{4}$ of a year.

Find the interest of:

4. \$950 at 6 % for 2 mo.
5. \$875 at 5 % for 3 mo.
6. \$1240 at $5\frac{1}{2}$ % for 4 mo.
7. \$1560 at 5 % for 1 mo.
8. \$2600 at $4\frac{1}{2}$ % for 3 mo.
9. \$3840 at 5 % for 2 mo.
10. \$1920 at 6 % for 3 mo.
11. \$2130 at $5\frac{1}{2}$ % for 2 mo.

Interest and Discount: Promissory Notes

When interest is paid in advance, that is, when the loan is made, it is called **bank discount**. When it is paid at the

time the note falls due or at some fixed time, it is called **simple interest.** Banks usually loan for short periods upon the bank-discount plan, while individuals perhaps more commonly loan upon the simple-interest plan. As evidence of the indebtedness, the one who loans the money requires a **promissory note.**

USUAL FORM OF DRAWING A NOTE

$1200. St. Louis, Mo., May 10, 1919

Three months after date I promise to pay to the order of the First National Bank of St. Louis twelve hundred and 00/100 Dollars at the First National Bank of St. Louis, Mo.

Value received

No. 184 Due Aug. 10, 1919 L. E. Mason

1. Was this loan made upon the bank-discount plan or the simple-interest plan? How can you tell?

2. Who borrowed the money and when?

3. Of whom was it borrowed? When will it be repaid?

4. Can you tell how much Mr. Mason paid the bank for the use of this money?

5. How many days was it from the time the money was borrowed until it was repaid?

Since some months have but 30 days and others 31 days, while February has but 28 or 29 days, banks consider each 30-day period a month in reckoning interest.

Thus, the bank considers the 3 months in the above note, which is 92 da., as 3 mo. 2 da., or $\frac{3}{12}\frac{2}{0}$ mo., or $\frac{9}{3}\frac{2}{6}\frac{2}{0}$ yr. If the rate charged was 6 %, the interest was

$$\frac{92}{360} \times \frac{6}{100} \times \$1200 = \$18.40.$$

6. If the bank charged $18.40 as bank discount, that left how much from the $1200 for Mr. Mason to use for the 92 days?

NOTE. — Since Mr. Mason has paid the interest in advance, he will have but the $1200 to repay on August 10.

7. Find the bank discount of $900 due in 43 days at 6 %.

Find the bank discount of:

8. $600 for 50 days at 6 %.

9. $750 for 36 days at 6 %.

10. $950 for 54 days at 6 %.

11. $1350 for 20 days at 5 %.

12. $1780 for 18 days at 6 %.

13. $2400 for 30 days at 5 %.

FORM OF AN INTEREST-BEARING NOTE

$800 *Detroit, Mich.,* Apr. 16, 1919

Four months *after date, for value received, I promise to pay to* J. D. Roberts *or order*

eight hundred *and* 00/100 *Dollars*

with interest at 6%

E. P. Dawson

1. Who is loaning the money and who is borrowing it?

2. Is this loaned upon the simple-interest or bank-discount plan? How can you tell?

NOTE. — Usually an individual considers four months as a third of a year regardless of the number of days. In this respect, the custom differs from that of a bank.

3. What will the interest be on the above note considering the time one third of a year?

4. How much will Mr. Dawson have to pay Mr. Roberts when the note is due?

5. What is the difference in amount of interest on the above note when reckoned on the exact number of days and when reckoned as one third of a year?

Find the interest of:

6. $750 at 6% for 46 da.
7. $980 at 5% for 58 da.
8. $935 at 6% for 3 mo.
9. $640 at 5½% for 4 mo.
10. $865 at 5% for 2 mo.
11. $1260 at 5% for 86 da.
12. $1350 at 5½% for 64 da.
13. $1760 at 6% for 28 da.
14. $1380 at 6% for 3 mo.
15. $1960 at 5% for 4 mo.

14. BORROWING MONEY FOR LONG PERIODS

When one borrows money for long periods, he usually has to pay the interest regularly either yearly or every half year. This is determined when the money is borrowed and is stated in the note.

Find the yearly interest of:

1. $1750 at 6%.
2. $1950 at 5½%.
3. $2600 at 5%.
4. $3850 at 5%.
5. $1880 at 6%.
6. $1740 at 5½%.

7. $1325 at 6%.
8. $9300 at 5%.
9. $1250 at 5½%.
10. $1670 at 5½%.
11. $1960 at 5%.
12. $1050 at 5½%.

Find the interest to be paid each half year on:

13. $3400 at 5%.
14. $4600 at 5%.
15. $2800 at 5½%.
16. $1650 at 6%.
17. $1470 at 6%.
18. $5200 at 5%.
19. $8600 at 5%.
20. $2960 at 5½%.

CHAPTER VII

PROBLEMS OF INVESTMENT

One of the interesting and necessary topics of arithmetic is the methods of investing money. It often happens that one ignorant of safe methods of investment loses the savings that he has spent much time and a great deal of hard work to accumulate. Usually when one is offered an investment making more than current rates of interest, it is because the risk of losing the money invested is greater than the risk taken when loaning money. This chapter is a discussion of a few of the safest and most common forms of investment.

1. LOANING MONEY ON SECURITY

When one has a few hundred dollars, he can loan it to some one who needs it and who will pay interest for the use of it. The interest paid for the use of money ranges from 5% to 7% for a year's use of the amount loaned, called the **principal**. Thus, the interest on \$100 at 5% is \$5 *per year;* at 6% it is \$6 *per year;* and at 7% it is \$7 *per year.*

When one loans money to another, he must have some evidence of the loan. So he requires what is called a *promissory note.* It was seen in the last chapter that this is a signed promise by the one to whom the money is loaned to repay it at a fixed time and to pay a fixed rate of interest (unless the interest is paid in advance or is not demanded) for the use of it.

1. If the following note is to cover a loan, who is the lender and who is the borrower?

$350 Charleston, S. C., April 10 1919

One year from date, for value received, I promise to pay to R. L. Simms or order three hundred fifty 00/100 Dollars with interest at 6%

E. R. Reid

2. When was the money borrowed and when is it to be repaid?

3. How long will Mr. Reid have the use of the money and how much will he pay for its use?

4. If your father loans $500 at 6 %, how much interest will he get for the loan each year?

5. Sometimes the borrower promises (in the note) to pay the interest *semi-annually*; that is, every half year. If a man loans $1000 at 5 % interest payable semi-annually, how much will he receive each half year? (The 5 % rate is the yearly rate.)

6. When one loans $8000 at $5\frac{1}{2}$ %, how much interest will he get each year? If the interest is paid every six months, how much will he receive in each payment?

7. How much interest will a man receive each half year from a loan of $3500 at 5 % payable semi-annually?

8. If a man buys a house for $8000, paying $4500 cash and giving his note at 6 % for the remainder, how much interest will he have to pay yearly?

Find the yearly interest from loans of:

9. $3400 at 5 %.
10. $2800 at 5½ %.
11. $7500 at 5 %.
12. $2750 at 6 %.
13. $5500 at 6 %.
14. $3800 at 5 %.
15. $5850 at 5½ %.
16. $6300 at 5½ %.
17. $7200 at 5 %.
18. $1750 at 6 %.

Find the semi-annual interest from loans of:

19. $6000 at 5 %.
20. $4000 at 6 %.
21. $7500 at 5 %.
22. $8000 at 5½ %.
23. $6500 at 6 %.
24. $2500 at 6 %.
25. $3500 at 5 %.
26. $7000 at 6 %.
27. $7000 at 5 %.
28. $3250 at 6 %.

2. FORMS OF SECURITY

One who loans money wishes, of course, to become reasonably secure from loss. Sometimes two or more sign the same note. Any one of those who sign the note thus becomes responsible for its payment. This kind of security is called **personal security**. Sometimes the borrower makes over certain property to the one of whom the loan is obtained as security. This is called a **mortgage**. If the interest is not paid when due or the loan is not repaid at the time agreed upon, the holder of the mortgage may sell the property and pay himself from the money received from the sale.

1. Mr. Harris buys a house of Mr. Lewis for $9500, paying him $5000 cash and giving him a note and mortgage to run 5 years at 6 %, payable semi-annually, for the balance.

(*a*) What is the *face* of the note; that is, the amount to be paid at the end of 5 years?

(*b*) Who gives the note? Who holds it?

(*c*) Who pays the interest? How much and when?

(*d*) What security has Mr. Lewis that he will receive the interest when due or the $4500 when due?

(*e*) Why do you suppose that Mr. Lewis would refuse to sell the house for $9500 and take a note and mortgage on the house for the full amount? If you do not know, try to find out from some older person.

2. If a man loans $5250 on a note and mortgage at 5½ % interest, payable annually, what is the yearly interest?

Drill Table

Find the interest of:

1. $750 at 5 % for 6 mo.
2. $960 at 6 % for 3 mo.
3. $1250 at 5½ % for 8 mo.
4. $840 at 5 % for 10 mo.
5. $1050 at 5½ % for 4 mo.
6. $1560 at 5 % for 6 mo.
7. $1470 at 6 % for 2 mo.
8. $1575 at 5 % for 9 mo.
9. $1600 at 5 % for 2 mo.
10. $1950 at 6 % for 1 mo.
11. $1820 at 5½ % for 5 mo.
12. $2040 at 5 % for 9 mo.
13. $2600 at 5½ % for 10 mo.
14. $3600 at 5 % for 11 mo.
15. $4500 at 6 % for 5 mo.
16. $2850 at 5½ % for 4 mo.

3. BUYING BONDS

A **bond** is a *promissory note* issued by some person or corporation, promising to pay the owner a fixed sum of money, called the **face** of the bond or its **par value**, at some fixed time, and to pay him a fixed rate of interest on the face of the bond at fixed times. Hence, when one buys a bond, he is merely loaning his money to the person or corporation that issued the bond. When buying bonds, one wishes, of course, to know what security there is back of the bonds. When a large stock corporation, as a manu-

facturing concern or a railroad, gives a bond, it is secured by a mortgage on the property of the corporation. Such bonds are **industrial bonds.**

When a city, county, state, or national government gives a bond, it cannot, of course, give a mortgage on the property of the city, county, state, or government; but the bonds are paid by a *tax* upon the property. These are called **tax bonds** and are considered the safest kind of bond investments.

1. Mary's father gave her a $500 Liberty Bond paying 4 % interest, payable semi-annually. How much interest will she receive every half year?

2. Mr. Roberts bought a railroad's promise to pay $15,500, paying 5 % interest. How much interest will he receive yearly?

3. A man bought two $1000 bonds issued by the same corporation. One paid 4 % interest and the other paid 5 % interest. For one he paid $982.50 and for the other he paid $1010. For which did he pay more and why?

4. If you own a $500 bond paying 5 % interest and due July 1, 1935, how much interest will you receive each year and how much, besides interest, will you receive on July 1, 1935?

5. If you paid $507.50 for the bond described in problem 4, how much more is that than you will get back at maturity not considering the interest you receive?

6. If you had paid $495 for the bond, how much less is that than what you get back at maturity?

When a bond sells for more than its face value, it is selling at a **premium**, or it is **above par.** When it sells for less than its face value, it is selling at a **discount**, or **below par.**

7. If you buy a bond below par and hold it until it is due, do you make or lose in addition to the interest? Explain to the class fully.

8. When a bond is bought above par and held until it is due, does the holder make or lose, not considering the interest received? Explain.

9. What do you suppose would cause a bond to sell for more than par value? For less than par value? If you cannot answer these questions, study the following and then see if you can give a good reason.

10. In buying a $1000 bond, you are buying a corporation's promise to pay $1000 at some future time, and to pay a certain rate of interest. If the corporation is dealing in something that the public may not need long, or if it is not making much money and you question its ability to pay the interest or the face of the bond, would you pay $1000 for it? Explain fully.

11. If a $1000 bond is paying 4% and you can loan your money on a note and mortgage at 6%, would you pay $1000 for the bond? Explain fully.

12. If a corporation's $1000 bond is paying 6% and the corporation is making money and likely to continue to do so, and you can lend your money on note and mortgage for but 5%, would it pay you to pay more than $1000 in order to get the bond?

Whether a bond sells above or below par depends largely upon the security back of the bond and the rate of interest it is paying compared with the general interest rates of money.

13. Describe a bond that you feel sure would sell above par.

14. Describe a bond that you feel sure would sell below par.

15. Which would you expect to sell for more, a \$1000 $4\frac{1}{4}\%$ Liberty Bond or a \$1000 $4\frac{1}{4}\%$ industrial bond? Explain.

16. The Third Liberty Bonds pay $4\frac{1}{4}\%$ semi-annually. What is each interest payment upon a \$100 bond? A \$500 bond? A \$1000 bond?

4. A SAVINGS BANK DEPOSIT

A **savings bank** is an institution for receiving and investing savings. It pays interest at stated intervals, usually semi-annually, upon the deposits. As the bank's income depends upon the rate of interest for which it can loan the deposits, the rate that it can pay the depositors is usually decided at the end of each interest period. The rate of interest paid by savings banks is usually 3%, $3\frac{1}{2}\%$, or 4%.

The laws of most states require savings banks to make such safe investments of the money of their depositors that a savings bank is one of the safest places to keep money, but the rate of interest earned is rather low.

When interest is due a depositor at a savings bank, it is not sent to him but it is added to his account and thus begins to draw interest. For example, if you have \$100 in a savings bank that is paying 4% interest semi-annually, there is \$2 due in 6 months. This is added to the \$100 and you then have \$102 drawing the interest for the next 6 months. At the end of this period the interest will be \$2.04. Then for the next 6 months you have \$104.04 drawing interest and the interest will be \$2.08. Then you have a credit of \$106.12 which draws \$2.12 for the next 6 months, and so on.

When the interest due at the end of an interest period is added to the principal and thus draws interest for the next period, the principal is said to be drawing **compound interest**, or the interest is said to be **compounded**. If the interest is

added every six months, it is **compounded semi-annually**; if but once a year, it is **compounded annually.**

1. If you have a savings bank deposit of $200 and the interest is compounded annually at 4%, how much will you have to your credit at the end of one year? At the end of two years? At the end of three years? At the end of four years?

2. During the year ending June 30, 1917, there were 11,367,013 savings bank depositors in the United States and the total deposits amounted to $5,418,022,274. Find: (*a*) the average deposit per depositor; (*b*) the interest on the total deposits for 1 yr. at 4%.

3. How much will $50 amount to in 4 years at 4% compounded annually?

4. If you had $500, tell the difference in income between depositing it in a savings bank paying 4%, buying a city bond at par paying 4½%, or loaning it on a note and mortgage at 6%.

5. In problem 4, tell which investment you would select and why.

The Compound Amount of $1, Interest Compounded Yearly

Yr.	3%	3½%	4%	Yr.	3%	3½%	4%
1	1.0300	1.0350	1.0400	11	1.3842	1.4600	1.5395
2	1.0609	1.0712	1.0816	12	1.4258	1.5111	1.6010
3	1.0927	1.1087	1.1248	13	1.4685	1.5639	1.6651
4	1.1255	1.1475	1.1699	14	1.5126	1.6187	1.7319
5	1.1593	1.1877	1.2167	15	1.5580	1.6754	1.8009
6	1.1941	1.2293	1.2653	16	1.6047	1.7340	1.8729
7	1.2299	1.2723	1.3159	17	1.6529	1.7949	1.9479
8	1.2668	1.3168	1.3686	18	1.7024	1.8575	2.0258
9	1.3048	1.3629	1.4233	19	1.7535	1.9225	2.1069
10	1.3439	1.4106	1.4802	20	1.8061	1.9898	2.1911

6. A savings bank paying 4% interest compounded annually advertised: "$100 deposited with us now will be worth $121.67 in 5 years, $148.02 in 10 years, $180.09 in 15 years, and $219.11 in 20 years. Watch the money grow." How were these results found from a table like the one on page 155?

7. If you could deposit $75 now in that bank, how much would it be worth in 8 years? In 15 years?

8. In January, 1918, one could get a government certificate worth $5 in five years for sixteen 25¢ war thrift stamps and 12¢. This was said to give 4% compound interest. Prove it by use of these tables.

5. ACCUMULATIONS FROM REGULAR DEPOSITS

There are many of us who are more interested in the amounts to which regular savings will amount than to the future amount of a fixed sum. Every one should form the habit of saving a fixed amount of his income. If the income is in the form of a salary coming in regularly, as weekly or monthly, the question of how much will be accumulated at some fixed time from regular deposits is of interest. The following questions will show how this is done.

1. If you should deposit $100 at the beginning of each year for 5 years in a savings bank paying 4% compounded annually, how much would you have at the end of 5 years?

The first $100 would amount to	$121.67.
The second $100 would amount to	$ . . . . .
The third $100 would amount to	$ . . . . .
The fourth $100 would amount to	$ . . . . .
The fifth $100 would amount to.	$ . . . . .
At the end of 5 years the amount would equal .	$ . . . . .

2. This is more easily calculated by a table like the following. Check your work by using this table:

The Amount Accumulated at the End of a Period of Years by Depositing $1 at the Beginning of Each Year of the Period

Yr.	3%	3½%	4%	Yr.	3%	3½%	4%
1	1.0300	1.0350	1.0400	11	13.1920	13.6020	14.0258
2	2.0909	2.1062	2.1216	12	14.6178	15.1130	15.6268
3	3.1836	3.2149	3.2465	13	16.0863	16.6770	17.2919
4	4.3091	4.3625	4.4163	14	17.5989	18.2957	19.0236
5	5.4684	5.5502	5.6330	15	19.1569	19.9710	20.8245
6	6.6625	6.7791	6.8983	16	20.7616	21.7050	22.6975
7	7.8923	8.0517	8.2142	17	22.4144	23.4997	24.6454
8	9.1591	9.3685	9.5828	18	24.1169	25.3573	26.6712
9	10.4639	10.7314	11.0061	19	25.8704	27.2797	28.7781
10	11.8078	12.1420	12.4864	20	27.6765	29.2695	30.9692

3. A saving of 20¢ per week is how much per year? $10.40 deposited each year for 10 years at 4% will amount to how much? (Use the tables.)

4. During his junior high school and senior high school courses (6 years) a boy earned and saved an average of $80 per year, which he deposited in a savings bank paying 4% compounded annually. At the end of 6 years, how much did it amount to?

5. For 10 years a young man deposited $800 per year in a savings bank paying 3½%. How much did he have to his credit at the end of the 10 years?

6. How much more would the young man in problem 5 have had could he have deposited it at 4%?

7. Make up problems of what you could save each week and see what the savings would amount to in a given time if you deposited them in a local savings bank. (Use the tables, but use the per cent your bank is paying, which will likely be 3%, 3½%, or 4%.)

6. THE POSTAL SAVINGS SYSTEM

The United States Government accepts interest-bearing **postal savings deposits** through certain authorized post offices and guarantees to pay them on demand.

Although savings banks are so carefully regulated by the laws of the various states that they are very safe places to deposit money, the Postal Savings System is even more safe, being backed by a guarantee of the government, and for that reason is preferred by many. The credit of depositors on June 30, 1916, was $80,775,586.

Any person 10 years old or over may have a postal savings deposit in his own name by depositing $1 or more at any post office authorized to receive such deposits. A person may deposit any number of dollars at any time until the balance of his credit amounts to $1000. The rate of interest paid is 2% from the first day of the month following the month in which the deposit was paid. No interest is paid for a fraction of a year.

Savings of less than $1 may be made by buying postal savings cards and stamps at 10¢ each. A savings card with nine stamps on it will be accepted as a deposit of $1.

A depositor may exchange the whole or any part of his savings for postal savings bonds in denominations of $20, $100, and $500 bearing $2\frac{1}{2}$% interest.

Without a pencil, give the interest for 1 year on :

1. $10.	5. $80.	9. $300.	13. $450.
2. $40.	6. $90.	10. $400.	14. $640.
3. $150.	7. $75.	11. $250.	15. $720.
4. $175.	8. $120.	12. $500.	16. $830.

17. Without a pencil, give the interest on a postal savings bond for $20. For $100. For $500.

18. What is the difference in income between $200 on deposit in a postal savings system and in $100 bonds? Are there any reasons why one might prefer the former?

19. Liberty Bonds issued by the United States Government in 1917 paid 4% interest. Compare the interest of a $500 Liberty Bond and a postal savings bond for the same amount.

20. The Third Liberty Loan Bonds, issued in May, 1918, paid 4¼% interest. Compare the interest on a $500 bond with that from five $100 postal savings bonds.

21. Which would you expect to sell for more in the market, a Liberty Bond or a postal savings bond? Explain.

7. INVESTING IN REAL ESTATE

Real estate is immovable property, as farms, houses and lots, city lots, stores, etc. The value of the farms in the United States and the buildings upon them is about $30,000,000,000. One sometimes buys real estate and **rents** or **leases** it to some one who wants it, for the **rent** it will pay, just as he loans money for the *interest*. Sometimes the buyer buys with the expectation of selling again at a profit.

1. A man bought a city house for $9500 and leased it for $70 per month. If the taxes and upkeep amounted to $225 per year, how much net income did his investment earn? Compare the net income with that from a city bond for $9500 paying 4½% interest.

2. A man leased for $40 per month a house that cost him $5200. The taxes and repairs amount to $115 per year. His net income is what per cent of the cost of the house? Would you consider this a good investment? Explain fully.

3. Do you know of a house that is rented? If so, see if you can find the amount of rent, taxes, repairs, and market value of the house, and compute the net rate of income on the market value. Would it pay to buy and rent it as an investment?

4. A man bought a farm of 80 acres at $45 per acre and sold it in 2 years for $65 per acre, having put the entire income from the farm for the time into taxes, buildings, and repairs. What per cent per year did his investment earn for him?

5. A man owns a house which he rents at $55 per month. Find whether this is more profitable than to sell, and loan the money at 6%. These are the data needed: Market value of the house, $7200; average yearly taxes, $125; estimated depreciation in value, $2\frac{1}{2}$%; average yearly repairs, $75; insurance, $18.

6. Find a profitable monthly rent for the following:

Interest 6 % of market value of $3500	$_____
Taxes $1\frac{1}{4}$ % of an assessed valuation of $3000	$_____
Depreciation in value 5 %	$_____
Repairs	$35.50
Insurance	$ 7.50
Yearly income necessary to make 6 % net	$_____
Monthly rent	$_____

7. Using the above form and local facts, investigate property in your neighborhood and see whether or not the property is earning a fair rate of income.

CHAPTER VIII

GEOMETRICAL CONSTRUCTIONS

On every hand we see patterns and designs, as in linoleum, tiled floors, metal ceilings, church windows, and in many other forms of decoration that depend upon a few very simple **geometrical constructions.** To understand these fundamental constructions adds greatly to our enjoyment and appreciation of them. And there are many references to **geometric terms** that we meet in general reading that we must understand if we are to interpret fully what we read.

1. DRAWING STRAIGHT LINES

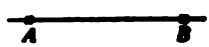
A good idea of a straight line is formed by stretching a string tightly between two points. To represent a straight line one places a ruler or straight edge upon a flat surface and marks along the edge of the ruler or straight edge.

1. Fold and crease a piece of paper to form a straight edge. Use it instead of a ruler in drawing a straight line.

2. Test the straight edge you have made as follows: Place it upon a flat piece of paper and mark along the edge. Now turn over the straight edge you have made and fit the edge to two points on the line you have drawn, and again mark along the edge. If the two lines coincide, the straight edge is accurate.

3. Test the straightness of your ruler as you did the straight edge which you made.

4. Test the straightness of line-segment AB by placing a very thin piece of paper over it and tracing it, marking points A' and B' over A and B respectively; now reverse the paper so that A' falls upon B and B' upon A. If the traced line-segment coincides with line-segment AB throughout, AB is a straight line.



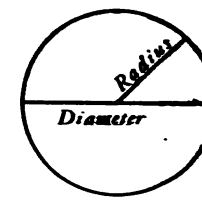
These tests make use of the fact that through two points one and only one straight line can be drawn. These two points are said to determine the straight line.

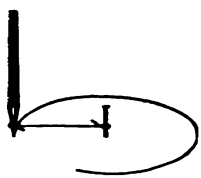
5. From this principle, show how you would extend any line-segment as AB, in exercise 4.

6. Show how the principle may be used in setting stakes in a straight line with any two given stakes.

2. DRAWING CIRCLES

A **circle** is a closed curve all points of which are equally distant from a point within called the **center**. The distances from all points of a circle to its center are called the **radii** of the circle. A single one of these is called a **radius**. Two radii in a straight line form a **diameter**. Any part of a circle is called an **arc** of the circle.



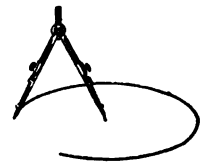


Arcs and circles are usually drawn by using a pair of **compasses**.

A good substitute for a pair of compasses consists of a piece of cord and a pencil or crayon as shown in the figure.

To use the compasses, the two legs are so adjusted that the distance between the two points equals the radius desired.

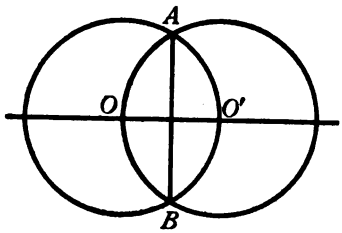
Then the fixed point of the compasses is placed upon the point that is to be the center of the circle and the other point of the compasses is moved about this center, tracing a circle.



1. Open the compasses so that it is just 1 inch between the points. Keeping the opening fixed, draw a circle with this radius. What is the diameter of the circle you have drawn?

2. Within the circle you have just drawn, and using the same center, draw a circle with a $\frac{1}{2}$-inch radius. These two circles having the same center are called *concentric circles.*

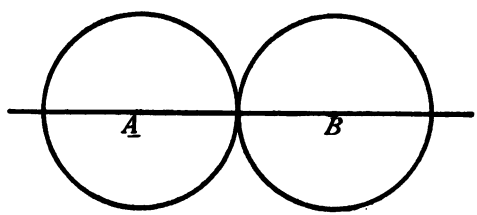
3. Draw a straight line and mark two points O and O' on it just 1 inch apart. With O and O' as centers, draw two circles with 1-inch radii. Connect the two points of intersection of the circles, A and B.



4. Draw any two equal circles that intersect each other and join their points of intersection, as in problem 3, and also join their centers. These two lines are *perpendicular* to each other; that is, they come together so as to form square corners.

NOTE. — Perpendicular lines will be discussed in section 9 of this chapter.

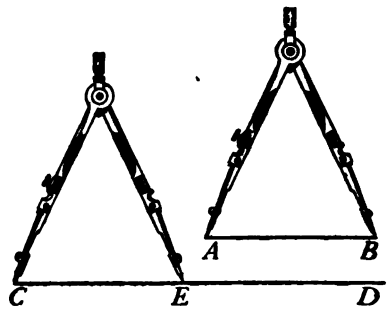
5. On a straight line take points A and B just 2 inches apart. With A and B as centers, draw two circles, each with a radius of 1 inch. If accurately drawn, these two circles will just



touch each other at the point where they intersect the line-segment AB joining their centers and are said to be *tangent* to each other at this point.

3. CONSTRUCTING AND MEASURING LINE-SEGMENTS

Two line-segments are equal if they can be made to coincide throughout. Compasses are used to lay off equal segments on a line, to construct a line-segment equal to a given line-segment, and to compare the lengths of line-segments. Thus, to mark off on CD a line-segment equal to AB, place one leg of the compasses at A and so adjust the compasses that the other leg will fall at B. Now with the adjustment unchanged, place one leg at C and with the other describe a small arc cutting CD at E. Then CE will equal AB.



1. Draw a line and mark off on it a segment equal to a given segment.

2. Draw a line and mark off three equal segments upon it.

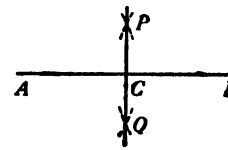
3. Draw a line-segment twice as long as a given segment.

4. Draw two line-segments that appear to be equal, then with the compasses compare them.

5. Try to draw one line-segment twice as long as another; then with the compasses see how nearly you estimated.

4. BISECTING A LINE-SEGMENT

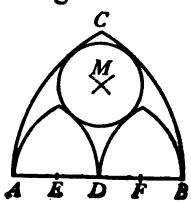
Any geometric magnitude is said to be **bisected** when it is divided into two equal parts. Compasses may be used in dividing a line-segment into two equal parts as follows: With the legs of the compasses farther apart than half the distance from A to B, place one leg at A and describe arcs on both sides of AB. Then, with the adjustment of the compasses unchanged, place one leg at B and describe arcs cutting the first arcs at P and Q. Draw a straight line from P to Q. The point C where it cuts AB bisects the segment AB at C. Show with your compasses that $AC = CB$.



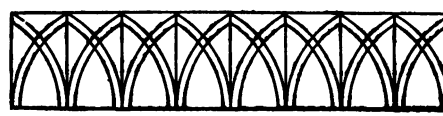
1. Draw several line-segments and bisect them. Test the accuracy of your work by means of the compasses.

2. Draw a line-segment and divide it into 4 equal parts. Into 8 equal parts.

3. This drawing is a design for a Gothic window. Draw a segment twice as long as AD. Divide it into 4 equal parts. Arcs AC and BC have radii equal to AB. M is the intersection of arcs of radii AF. Study the figure carefully and see how all parts are constructed, then construct a similar one on the segment you have made.

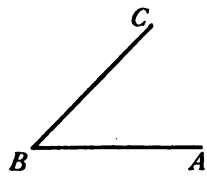


4. The following design depends upon dividing a segment into 8 equal parts. Study the figure to see how the arcs are drawn, then make a similar design twice as long as this one.



5. CONSTRUCTING AND MEASURING ANGLES

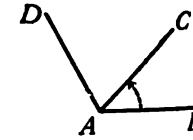
Two lines drawn from a point, as BA and BC drawn from B, are called **rays** and the figure formed is called an **angle.**

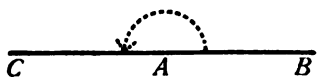


The point B where they meet is called the **vertex** of the angle and the two rays, BA and BC, are called the **sides of the angle.**

This angle is called "angle ABC," the letter at the vertex being read between the other two. The symbol $\angle$ is used instead of the word "angle" and the above angle is written $\angle ABC$.

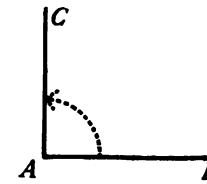
The size of an angle does not depend upon the lengths of its sides, but upon the relative directions of the sides. It may be measured by the amount of turning about the vertex required of one side to make it fall upon the other. Thus, $\angle BAD$ is larger than $\angle BAC$, for AB would have to be revolved about A farther to fall upon AD than to fall upon AC.





When the two rays of ar angle, as AB and AC, are in a straight line, they are said to form a **straight angle.**

An angle like the one in the margin is half of a straight angle and is called a **right angle.**

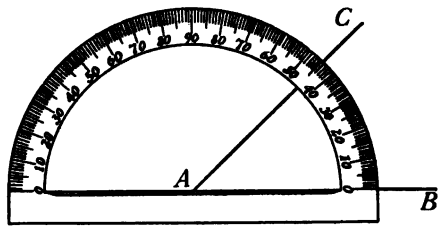


The Measurement of Angles

If a right angle is divided into 90 equal parts, each of these parts is called a **degree,** which is the unit of measure in measuring angles. Hence a right angle contains 90 degrees, written 90°. Each degree is divided into 60 parts

called minutes (60′) and each minute into 60 parts called seconds (60″).

The instrument shown here is a **protractor** and is used to measure angles. Thus, placing it upon $\angle BAC$ as shown here, it is seen that the angle is one of 45 degrees.



1. Draw any angle and by the use of a protractor find how many degrees are in it.

2. Draw any angle and by the use of the protractor draw another of the same size.

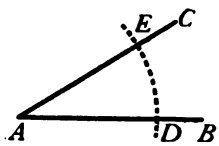
3. By the use of the protractor draw a right angle.

4. Draw angles of 30°; of 40°; of 100°; of 120°.

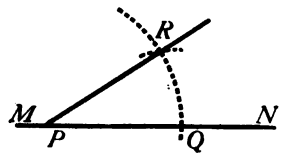
5. At what angle are the hands of a clock at 2 o'clock? At 3 o'clock? At 5 o'clock?

6. CONSTRUCTING ANGLES EQUAL TO A GIVEN ANGLE

Without a protractor an angle can be drawn equal to any other. Thus, to draw an angle equal to angle BAC, the steps are as follows:



Take a line MN and select any point P on the line. With center A describe any arc cutting sides AB and AC in D and E respectively. With P as center, and without changing the adjustment of the compasses, describe an arc cutting PN at Q. Now with one point of the compasses at D, adjust the arms so that the point of the other arm will fall



at E. With the same adjustment, describe an arc about Q as center, cutting the first arc at R. Now join P and R and $\angle QPR = \angle BAC$. Test this by use of your protractor.

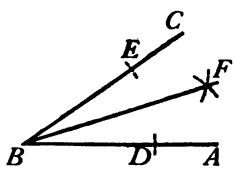
1. Draw any angle and by the above method construct another angle equal to it. Test the accuracy of your construction by the use of your protractor.

2. Draw any two angles. Can you discover a way to draw an angle as large as their sum? If so, do it and test your construction by the protractor.

3. Can you discover a way of constructing an angle twice as large as another? If so, construct an angle double another and test the accuracy by the protractor.

7. BISECTING ANGLES

To bisect an angle, as $\angle ABC$, take any radius and describe an arc about B as center, cutting sides AB and BC in D and E respectively. Now with any radius describe arcs about D and E as center, using the same radius in each, cutting at F. Connect BF. $\angle ABF = \angle FBC$. Test it by the protractor.



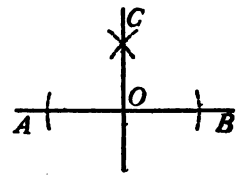
1. Draw any angle and bisect it. Test your construction by use of the protractor.

2. Divide an angle into 4 equal parts.

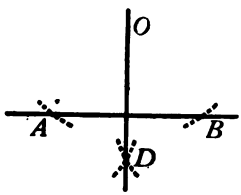
8. DRAWING PERPENDICULARS TO A LINE

If two intersecting straight lines form right angles, the lines are **perpendicular** to each other. A perpendicular can be drawn to a straight line either from a point on the line or from a point without the line. If the point is on the line, as

O, with this center, and with any radius, describe arcs cutting the line at A and B. Then with A and B as centers, and with any radius, remaining the same in both, describe arcs intersecting at C. Then CO is the perpendicular from O to AB. Check this by the protractor.



When the point O is without the line AB, with it as center, arcs are drawn cutting AB as before. Then with these intersections as centers, arcs are drawn intersecting at D as in the first case. Then OD is the perpendicular from O to AB. It will be noticed that the two methods are the same.



1. Draw a straight line and from any point in it erect a perpendicular to the line. Test the construction with your protractor.

2. Draw a straight line and from any point without the line draw a perpendicular to the line. Check your work with a protractor.

3. Draw perpendiculars to a line both from a point on the line and from a point without the line until the method is fixed in mind.

4. Draw two intersecting lines perpendicular to each other, thus forming 4 right angles, and then bisect each right angle. How many degrees in each of these angles?

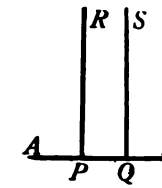
5. Construct, by bisecting these angles again, an angle of $22° 30'$.

6. Draw a circle and then draw diameters dividing the circle into 8 equal parts.

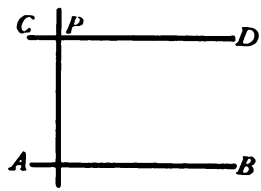
7. Study the design shown here and see the method of constructing it. Then construct one, beginning with a circle with twice the diameter of this design.

9. DRAWING A STRAIGHT LINE PARALLEL TO ANOTHER

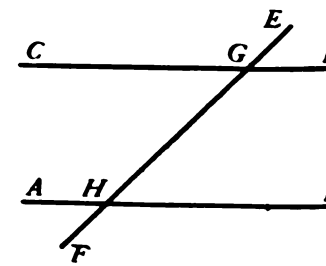
Draw a straight line AB and from two points on it, as P and Q, erect perpendiculars. These two perpendiculars, PR and QS, are **parallel** to each other. However far they may be extended, these lines will never meet.



1. Show that a straight line CD may be drawn through a given point P and parallel to a given line AB by first drawing a perpendicular to the line from a point without the line, and then drawing a perpendicular to a line from a point on the line.

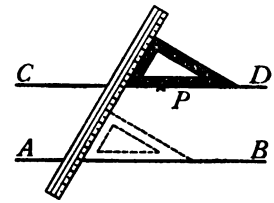


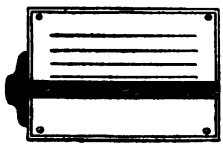
2. Draw two parallel lines AB and CD. Now draw any straight line cutting the two parallels in G and H. By use of a protractor, compare angles BHE and DGE. If this work is accurate, these two angles are equal.



3. The fact that angles BHE and DGE are equal suggests a second method of drawing parallel lines. For it is true that if those angles are equal, CD and AB are parallel. It is from this principle that parallel lines may be drawn by use

of a draftsman's triangle as follows : Place the triangle with one side along the given line *AB*. Then adjust a ruler against the other side of the triangle. Holding the ruler in this position, slide the triangle along it until the side that was along *AB* comes to the given point *P*. Then draw a line *CD* along this side.





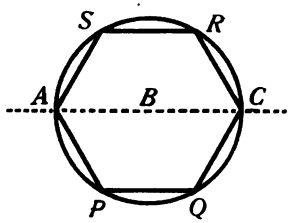
4. By use of a triangle and a ruler, draw a line through a given point parallel to a given line.

5. What principle is the draftsman using when he draws parallel lines by means of a T-square as shown here ?

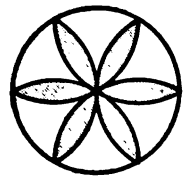
6. What principle is the carpenter using when he draws parallel lines by use of a carpenter's square, moving one blade along an edge of the board and marking along the other, as shown in the figure ?

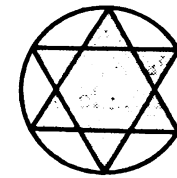
10. DRAWING GEOMETRIC PATTERNS AND DESIGNS

The constructions already given, together with a method of constructing the figure shown in the margin, called a **regular hexagon**, form the basis for many interesting and ornamental designs. The point *B* is the point of bisection of *AC*. Arcs are described about *A*, *B*, and *C* as centers, and with *AB* as radius, cutting in *P*, *Q*, *R*, and *S*. The regular figure *APQCRS* is a *regular hexagon.*

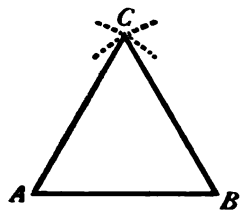


1. Draw the following designs. Erase all but the heavy lines.

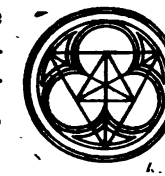


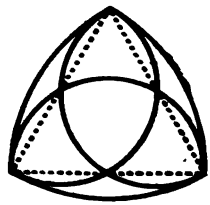


2. A figure like the one in the margin is called an *equilateral triangle*. To draw it, take two points A and B as centers, and the distance between them as the radius of arcs intersecting at C. This is the basis of many interesting patterns.



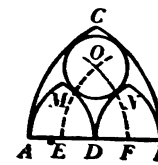
3. This is the outline of a design used in ornamental windows. Study it and discover the method of construction. Make one on a larger scale, erasing all but the heavy lines.



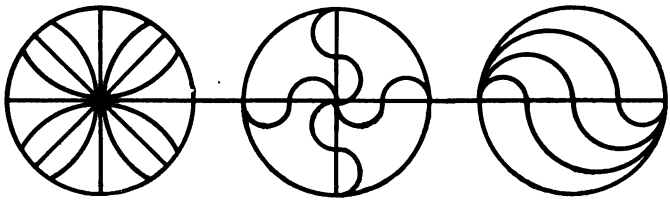


4. This is also a design for an ornamental window. Study the construction, then make one on a larger scale and erase all but the heavy lines.

5. The design in the margin is that of a Gothic window. AB, the base, was divided into 4 equal parts. Each of the points, A, D, F, E, and B, is a center for some of the arcs. Study the figure carefully and draw one with three times as large a base. Erase all lines used in the construction, leaving the figure in the margin.



6. Study the following and construct them on a larger scale:



7. Find designs in windows, metal ceilings, linoleum, or other patterns, and see if you can discover how to construct them.

CHAPTER IX

MEASURING AREAS: THE FORMULÆ

All about us are surfaces to be measured, as floors, walls, walks, lawns, gardens, fields, etc. These are measured as all other kinds of quantities are measured; that is, a standard unit of measure is applied and the numerical measure of the quantity is the number of times it contains this standard unit. In measuring areas, the unit of measure is a square whose side is some linear unit, such as a square inch, a square foot, a square yard, etc. There are also other units, as the acre, which is 160 square rods.

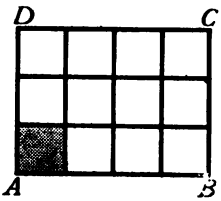
All plane areas bounded by straight line-segments are called **polygons.** Those having but four sides are called **quadrilaterals.** The four most important quadrilaterals are

discussed in this chapter. They are rectangles, squares, parallelograms, and trapezoids.

1. THE AREA OF A RECTANGLE

The figure $ABCD$ is called a **rectangle.** It has four straight sides of which the opposite sides are parallel, and its angles, formed by the sides, are all right angles. The two sides at right angles to each other, as AB and BC, are called

the **base** and **altitude** respectively. Together they are called the **dimensions** of the rectangle. If the dimensions are equal, the figure is called a **square**.



To measure the rectangle, we find how many square units it will contain. If the base AB is 4 units long, it may be laid off into 4 parts each 1 unit long. Likewise if BC is 3 units long, it can be laid off into 3 parts each 1 unit long. Lines drawn from these points, as shown in the figure, divide the rectangle into squares. And there are as many squares along each dimension as there are units in these dimensions. In the figure there are 3×4 squares. If each square represents a square foot, then the area is 12 square feet. Hence, we have :

$$\text{Area} = 3 \times 4 \text{ sq. ft.} = 12 \text{ sq. ft.}$$

And in general,

The number of square units in the area of any rectangle is the product of the number of linear units in the two dimensions.

This statement is often expressed by a **formula**, using A for area, b for base, and a for altitude, thus :

$$A = ab.$$

This means that the product of a and b is the *number* of squares in the area.

The absence of a sign between two letters in a formula indicates multiplication.

1. What is the area of a rectangle whose dimensions are 8 ft. and 12 ft.? 7 yd. and 8 yd.? 9 in. and 12 in.?

2. Find A when $a = 3$ rd. and $b = 6$ rd.

This should be written $A = 3 \times 6$ sq. rd. $= 18$ sq. rd.

Using the formula, find the areas of the following rectangles:

3. 16 ft. by 18 ft.
4. 14 ft. by $26\frac{1}{2}$ ft.
5. $12\frac{1}{2}$ rd. by 16 rd.
6. 24 yd. by $18\frac{3}{4}$ yd.
7. 16 in. by $28\frac{1}{2}$ in.
8. 26.2 rd. by 18.7 rd.
9. 36.8 ft. by 24.5 ft.
10. 42.6 in. by 28.1 in.
11. 16.9 yd. by 26.2 yd.
12. 12.8 ft. by 16.3 ft.

13. How much will it cost to build a cement walk 4 ft. wide and 120 ft. long, at 18¢ per square foot?

14. How much will it cost at 16¢ per square foot to build a 4-foot walk across the front and along one side of a corner lot 80 ft. by 225 ft.?

15. Find the cost to build cement walks in your city and then measure and compute the cost of building the walk in front of your own home along the full width of the lot.

16. Compute the cost of laying the walk about your school building at local prices.

17. A garden 50 ft. by 64 ft. has a 3-foot walk laid out on all four sides, within the garden. It was constructed of gravel at a cost of 25¢ per square yard. Find the cost.

18. A city lot with a frontage of 80 ft. and a depth of 200 ft. sold for $40 per foot of frontage. How much per square foot was this? Show why 80 need not be used in the solution.

19. At $1.75 per running yard, find the cost of covering a floor 18 ft. wide and 20 ft. long with linoleum 6 ft. wide.

20. A farmer got 144 bu. of potatoes from a patch 8 rd. by 12 rd. Find the yield per acre.

21. At 5 ¢ per square foot, how much will it cost to sod a yard 60 ft. by 175 ft., deducting for a building 36 ft. by 40 ft.?

22. How many paving blocks 4 in. by 4 in. by 10 in. are needed to pave a street 36 ft. wide and 1260 ft. long?

23. A city park is 520 ft. by 710 ft. How many acres does it contain?

24. How many square feet in the walls and ceiling of a room 22 ft. wide, 28 ft. long, and 9 ft. high?

25. If a roll of wall paper 8 yd. long and 18 in. wide costs 60 ¢, find the cost of the paper for the walls of a room 16 ft. wide, 24 ft. long, and $8\frac{1}{2}$ ft. high, not deducting for openings.

26. Some contractors estimate the cost of building a house from the number of square feet in the "floor plan." At $7.80 for each square foot in the area of one floor, find the cost of building a house 34 ft. by 38 ft.

27. At the same rate, how much more will a house 2 ft. wider and 4 ft. longer cost?

28. At the same rate, how much less will a house 6 ft. narrower and 4 ft. shorter cost?

29. If you know some builder, see if he estimates the cost from the "floor plan," and if so, get his price and estimate on the cost of buildings of given sizes.

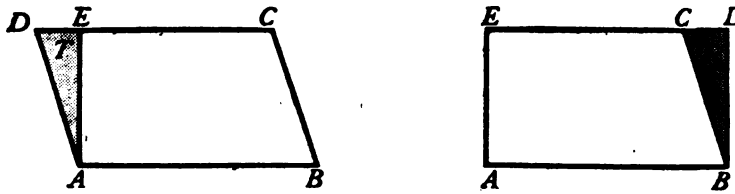
30. Measure the kitchen floor for your mother and find the cost to cover it with linoleum, using the cost at some local store.

31. Find other uses that you can make of your knowledge of how to measure rectangles.

2. THE AREA OF A PARALLELOGRAM

A **parallelogram** is a figure of four straight sides whose opposite sides are parallel, but the angles need not be right angles as in the rectangle.

It will be seen that lines drawn parallel to the sides, as in finding the area of a rectangle, would not divide the area of a parallelogram into squares, for the sides are not perpendicular to each other. But by drawing a perpendicular from one corner, cutting off triangle *T*, and placing it at the other



end of the parallelogram, a rectangle is formed with the same base as that of the parallelogram, and having the same width. It is seen, then, that a parallelogram has the same area as a rectangle with the same base and altitude. That is,

The number of square units in the area of any parallelogram is the product of the number of linear units in its base and the number of linear units in its altitude.

Observe that the altitude is the length of the perpendicular that was dropped from one corner to cut off the triangle.

Expressed by a formula, this is the same as that for a rectangle; that is,

$$A = ab.$$

1. Carefully construct a parallelogram on heavy paper or cardboard. From one corner erect a perpendicular to the other side. Cut off the triangle thus formed and place it at

the other end, thus forming a rectangle. Has the base, altitude, or area been changed?

By use of the formula, find the areas of parallelograms whose dimensions are:

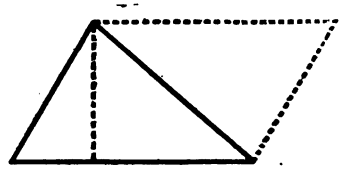
2. Base, 20 ft.; alt., $12\frac{1}{2}$ ft.
3. Base, $34\frac{1}{2}$ ft.; alt., 16 ft.
4. Base, 48 yd.; alt., 20 yd.
5. Base, 8 rd.; alt., $12\frac{1}{2}$ rd.
6. $a = 12.4$, $b = 16.3$.
7. $a = 26.2$, $b = 34.2$.
8. $b = 16.5$, $a = 8.42$.
9. $b = 24.2$, $a = 16.25$.

10. A strip of land in the form of a parallelogram measures 48 rd. along one side and is 6 rd. wide. How many acres does it contain?

11. One seldom sees common areas, as walks, gardens, fields, etc., in the form of a parallelogram. The figure is studied mainly on account of its aid in finding the area of a triangle. If you can find any area in the form of a parallelogram, measure its base and altitude and find its area.

3. THE AREA OF A TRIANGLE

A **triangle** is a figure of three straight sides. Any one of the three sides may be considered the **base**, and the perpendicular distance to that side from the opposite corner is the **altitude**. By constructing two triangles of the same size and shape and placing them as in the diagram, it is seen that they form a parallelogram of which each triangle is one half of the parallelogram. Then from the measurement of a parallelogram we have the following formula for the area of a triangle:



$$A = \frac{ab}{2}.$$

State in words the fact expressed by this formula.

1. Find the area of a triangle whose base is 12 in. and whose altitude is 8 in.

2. A road cuts off a corner of a field, giving a piece of land in the form of a triangle whose two sides are at right angles to each other, and which are 8 rd. and 12 rd. long, respectively. What decimal part of an acre is in the plot?

Using the formula, find the area of triangles when:

3. Base = 20 ft.; alt. = $16\frac{1}{2}$ ft.

4. Base = 16 rd.; alt. = $14\frac{3}{4}$ rd.

5. Base = 32 yd.; alt. = $24\frac{1}{8}$ yd.

6. Base = 32 in.; alt. = $24\frac{5}{8}$ in.

7. Base = $17\frac{1}{2}$ in.; alt. = $14\frac{1}{2}$ in.

8. Base = 13.2 rd.; alt. = 16.5 rd.

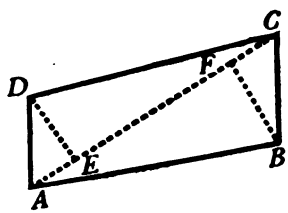
9. Base = 24.5 ft.; alt. = 16.75 ft.

10. Base = 20.3 rd.; alt. = 16.83 rd.

11. A triangular plot is 8.5 rd. along one side. From the opposite corner to this side is 6.4 rd. What decimal part of an acre is the plot?

12. Find some triangular areas, take the necessary measurements, and find the areas.

13. How many square feet in the gable end of a barn in the form of a triangle with a base of 32 ft. and an altitude of 12 ft.?

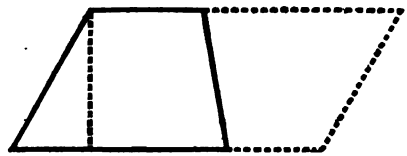


14. The diagram $ABCD$ is that of an irregular field. Its area can only be found by dividing it into triangles, measuring the triangles, and adding the areas. The measurements are $AC = 30$ rd., $DE = 8$ rd., $BF = 10$ rd. How many acres in the field?

15. By the method used in problem 14, find the areas of irregular figures.

4. THE AREA OF A TRAPEZOID

A **trapezoid** is a figure of four straight sides of which two opposite sides are parallel and the other two are not parallel. The two parallel sides are called the **upper** and **lower bases**, and the perpendicular distance between the bases is the **altitude**. By constructing two trapezoids of the same size and shape and placing them as shown in the diagram, it is seen that they form a parallelogram whose base is the sum of the two bases of the trapezoid and whose altitude is the same as that of the trapezoid. Hence, the area of the trapezoid is just half of the parallelogram thus formed. From this we have the principle that,



The number of square units in the area of any trapezoid is one half of the product of the number of linear units in the altitude and the sum of the number of linear units in the two bases.

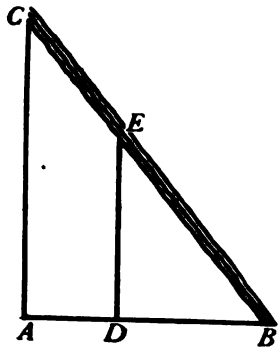
Expressed as a formula, this is

$$A = \frac{a(b+b')}{2}.$$

1. Find the area of a trapezoid whose bases are 24 ft. and 18 ft. respectively, and whose altitude is 9 ft.

2. The diagram (next page) is that of a triangular field formed by a creek cutting off a corner from a rectangular field. $AC = 25$ rd., and $AB = 20$ rd. If a strip $ADEC$ 8 rd. wide has been plowed, what per cent of the whole field is that?

ANALYSIS OF THE PROBLEM. — The area of the entire triangle can be found for sufficient data is given. But either the area of the trapezoid *ADEC* or of the triangle *DBE* must be found in order to answer the question. Either of these areas requires the length of line *DE*. This involves a problem not yet studied but which is easily seen. It will be observed that triangles *ABC* and *DBE* have the same shape. Hence they are said to be *similar*. When triangles are similar, the relation of corresponding sides always remains the same. In triangle *ABC*, side *AC* is one fourth longer than side *AB*. Then side *DE* must be one fourth longer than *DB*. Now you can easily finish the problem.

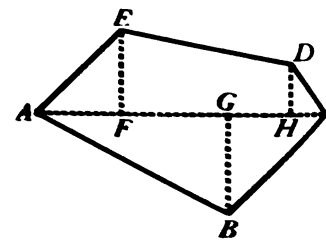


3. Draw a figure somewhat similar to the one in problem 2, but where $AC = 40$, $AB = 30$, and $AD = 12$, and then find what per cent of the field remains unplowed if plot *ADEC* is plowed.

By use of the formula, find A when:

4. $a = 10$, $b = 15$, $b' = 12$.
5. $a = 8$, $b = 16$, $b' = 14$.
6. $a = 12\frac{1}{2}$, $b = 18\frac{1}{4}$, $b' = 14\frac{3}{4}$.
7. $a = 11\frac{1}{4}$, $b = 20$, $b' = 16\frac{1}{2}$.
8. $a = 4.2$, $b = 16.2$, $b' = 10.8$.
9. $a = 16.5$, $b = 2.04$, $b' = 18.6$.
10. $a = 14.8$, $b = 16$, $b' = 12.5$.
11. $a = 20$, $b = 15.3$, $b' = 11.8$.

12. Here is a plot of a field. From the following data find the area of the field: $AC = 30$ rd.; $BG = 10$ rd.; $AF = 8$ rd.; $EF = 8$ rd.; $DH = 6$ rd.; $HC = 4$ rd.



13. Find figures whose areas you can find only by dividing them into triangles and trapezoids and bring them to class for solution.

5. THE MEASUREMENT OF THE CIRCLE

If the distance around some large circular object, called the **circumference**, is carefully measured and this length divided by the diameter of the circle, it will be found that, whatever the size of the circle, the quotient will always be the same. If all measurements are carefully made, this quotient will be found to be 3.1416, usually represented by the Greek letter π (Pi). Hence,

Circumference = 3.1416 × diameter = 3.1416 × 2 × radius.

Expressed as a formula, this is

$$C = \pi d = 2\pi r.$$

It should be observed from this that to any change in the diameter there is a corresponding change in the circumference just π times as great; and to any change in the radius there is a corresponding change in the circumference just 2π times as great.

1. If the diameter of a circle is 20 ft., what is its circumference?

2. If the radius is 15 ft., what is the circumference?

3. From the relation $C = \pi d$, how would you find the diameter when the circumference is known?

NOTE. — Your answer follows from the meaning of division. C is the product of two factors of which one of them (π) is known, and the problem is to find the other. Hence $C \div \pi = d$, or $d = \frac{C}{\pi}$.

4. From the relation $C = 2\pi r$, show how to find r.

5. Some boys wish to lay off a circular running track that will measure just $\frac{1}{8}$ of a mile (660 ft.) around. How long a string, to be used as a radius, will they need?

6. If they lay off a track using a radius of 200 ft., they will have a running track that is what decimal part of a mile around?

7. Find the diameter of a wheel that makes 660 revolutions in going a mile.

8. How many revolutions per mile does a 36-inch automobile wheel make?

9. If a 34-inch automobile wheel is making 180 revolutions per minute, how fast is the machine traveling per hour?

10. If a 34-inch and a 36-inch automobile wheel are each making the same number of revolutions per minute, the machine with the larger wheel is traveling how much faster?

SUGGESTION. — One is carried 36π inches while the other is carried 34π. The difference is what fractional part of 34π?

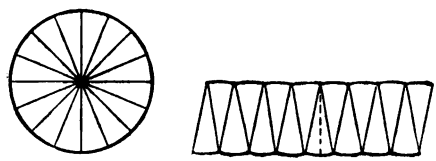
11. It is by the known distance traveled by each revolution of the wheel of an automobile that a speedometer registers the distance and speed. So in reality it registers revolutions. See if through a careful study of problem 10, you can find what correction to make in the reading of a speedometer when it was made for a machine using a 32-inch tire and a 33-inch tire is being used.

12. In many gymnasiums there are running tracks with parallel sides and semicircular ends. In others, they are circles. Show clearly that in either form and independent of the length of the tracks, when two athletes are running so that one is 3 ft. farther from the inner curb than the other, he has to run 6π, or 18.8496 ft., farther each lap than the other does.

13. The *rim speed* of a revolving pulley is the rate at which a point of the rim is traveling as the pulley revolves. Find the rim speed of a 24-inch pulley making 300 revolutions per minute.

Measuring the Area of a Circle

It is seen that a circle cannot be divided up into squares as the rectangle could. It will be remembered, too, that in finding the area of triangles and trapezoids, their relation to a parallelogram of known dimensions was found. The same method is used in finding the area of a circle.



A *B*

Draw a circle on stiff cardboard and cut it into at least sixteen equal sectors as shown in figure *A*. This you can do from the work in geometrical constructions that you have had. Then fit the sectors into a figure like figure *B*. While this is not a perfect parallelogram, had the sectors been made very small, it would have approached one so nearly that we are able to conclude that,

The area of any circle is equal to that of a parallelogram whose base is half of the circumference, and whose altitude is the radius.

Stated as a formula, we have

$$A = \frac{c}{2} \times r = \frac{cr}{2}.$$

But since $c = 2\pi r$, $\frac{c}{2} = \pi r$. Substituting this value for $\frac{c}{2}$, the formula becomes $A = \pi r^2$.

The expression r^2 means $r \times r$ and is read "r square."

1. Find the area of a circle whose radius is 15 ft.

2. A circular pond is 400 feet across. How many acres does it cover?

3. A 4-foot cement walk surrounding the circular basin of a fountain 24 feet in diameter was made for 20¢ per square foot. Find the cost.

4. An ice cutter gathered all the ice from a circular pond 300 feet in diameter. The average thickness was about 14 inches so that he got a 65-pound cake of ice from every square foot of the surface of the lake. How many tons were in the entire crop?

5. Since $2r = d$, $r =$ what part of d? Write a formula for r in terms of d.

6. Since $r = \frac{d}{2}$, $r^2 =$ what part of d^2? Write a formula for r^2 in terms of d^2.

7. Substitute $\frac{d^2}{4}$ for r^2 in the formula $A = \pi r^2$ and derive a formula for A in terms of πd^2.

8. Show that $A = \frac{\pi d^2}{4} = .7854 \times d^2$ and give the rule for finding the area of a circle as expressed by the formula.

9. By the formula of problem 8, find the area of a circle whose diameter is 15 ft.

10. Compare the area of a 15-foot circle with that of a 20-foot circle.

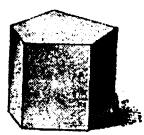
CHAPTER X

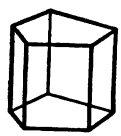
MEASURING SURFACES AND VOLUMES OF SOLIDS: THE FORMULÆ

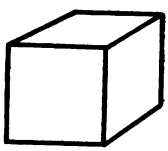
The **volume** of a solid is the measure of the solid when the unit of measure is some cube whose edge is a linear unit. Thus, if a solid can be divided into 10 cubes, each with an edge of 1 inch, the volume of the solid is 10 cubic inches.

1. THE VOLUME OF A RECTANGULAR PRISM

A **prism** is a solid bounded by flat or plane surfaces, two of which are equal polygons, called the **bases**, and lying in parallel planes; and the other surfaces are parallelograms of which each has sides of the bases as two of its opposite sides. The parallelograms are called the **lateral faces** of the prism.



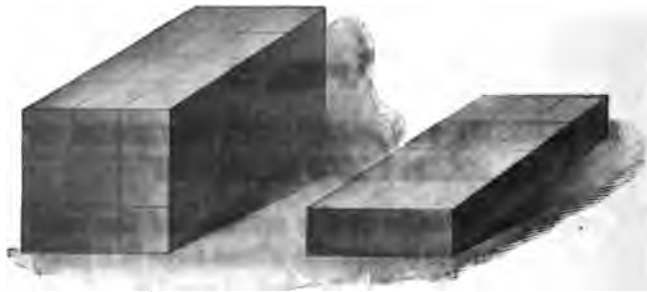




If the bases and lateral faces are all rectangles, the prism is a rectangular prism. If all are squares, the prism is a **cube.**

Just as the area of a rectangle was determined by dividing it into squares, so the volume of a rectangular prism is found by dividing it into cubes. Thus, if the prism on page 188 is 3 inches wide, 3 inches high, and 4 inches long, it may be divided into 3 layers each containing 12 cubic inches. It is seen that the number of cubes in 1 layer is the number of squares in the base

or the product of two of the dimensions. Also, the number of such layers is the number of units in the other dimen-



sion. Thus, in the figure, there are 4×3 cubic inches in one layer, and $3 \times 4 \times 3$ cubic inches in the whole prism. And in general,

The number of cubic units in any rectangular prism is equal to the product of the number of linear units in its three dimensions.

Or, since the number of cubic units in one layer is the number of square units in the base, it is seen that:

The number of cubic units in any rectangular prism is equal to the product of the number of square units in the base and the number of linear units in the altitude.

Expressed in formulæ, these are

$$V = lwh;$$

and

$$V = Bh.$$

1. Find the volume of a block of granite 36 inches long, 14 inches wide, and 12 inches high.

2. In using the formula, it does not make any difference which dimension is represented by a given letter.

In problem 1, if $h = 36$, what does B equal?

3. How many bushels of wheat will a freight car 36 ft. long and $8\frac{1}{2}$ ft. wide contain if loaded to a depth of $5\frac{1}{2}$ ft., allowing .8 bu. per cubic foot?

4. If a builder contracts at 35¢ per cubic yard to have an excavation for a building dug 86 ft. wide and 40 ft. long, and to an average depth of $6\frac{1}{2}$ ft., how much will it cost him?

5. If a farmer has a bin 12 ft. wide and 14 ft. long filled to a depth of 5 ft. with oats, how many bushels has he, allowing .8 bu. per cubic foot?

6. If your coal bin is 10 ft. wide and $12\frac{1}{2}$ ft. long, how many tons of coal have you when it is filled to a depth of $4\frac{1}{2}$ ft., allowing 63 lb. of coal per cubic foot?

7. How many gallons of water will it take to fill a swimming tank 48 ft. wide and 64 ft. long if the average depth is $5\frac{1}{2}$ ft., allowing 7.48 gal. per cubic foot? How much will it cost to fill such a tank at the cost of water in your town or city?

8. If an ice-man delivers a cake of ice 8 in. thick, 14 in. long, and 10 in. wide, find its weight at $56\frac{1}{4}$ lb. per cubic foot.

9. A concrete watering trough is 8 ft. long, 30 in. wide, and 14 in. deep, inside measure. How many gallons will it contain, allowing 231 cu. in. per gallon?

10. The number of cubic inches per gallon is 231, but in finding the approximate number of gallons, when dimensions are given in feet, $7\frac{1}{2}$ gallons per cubic foot is used. Such a calculation will give an error of how much in problem 9?

11. From the meaning of division, viz.: having given the product of two numbers and one of them, division is the process of finding the other, we may find the height of a prism when the volume and area of the base are known. Explain how and why.

12. From the formula $Bh = V$, we obtain $B = \frac{V}{h}$ and $h = \frac{V}{B}$. Interpret these results as rules for finding the area of the base when the volume and height are known; and for finding the height when the volume and the dimensions of the base or its area are known.

13. If I wish to have a coal bin that will hold my winter's supply of 14 tons of coal, how many square feet must the floor of the bin contain if the bin is to be filled to a depth of but $5\frac{1}{2}$ feet, allowing 63 pounds per cubic foot?

SOLUTION

$$\frac{\overset{2}{\cancel{14}} \times 2000}{\underset{9}{\cancel{63}}} \times \frac{2}{11} = \frac{8000}{99} = 81, \text{ nearly.}$$

Hence, about 81 sq. ft.

EXPLANATION. — 14×2000 = the number of pounds. This product divided by 63 = the number of cubic feet of coal. This divided by $5\frac{1}{2}$ = the number of square feet in the base (area of the floor).

14. If a bin is to hold 18 tons when filled to a depth of 5 feet, what will the floor area have to be?

15. If the floor area of a bin is 85 square feet, to what depth will it have to be filled to hold 15 tons?

16. The amount of grain raised in a given year can be more adequately visualized by picturing a bin that it would take to hold it. In 1917 our wheat crop was approximately 656,000,000 bu. To what depth would it fill a bin a mile square, allowing .8 bu. per cubic foot? (This problem is just like problem 15. Give your answer in feet.)

17. Our average corn crop for several years has been 2,700,000,000 bu. To what depth would this fill a bin a mile square allowing .4 bu. per cubic foot for corn in the ear?

18. Get data for other cereal crops and find the sizes of bins required to hold them.

2. SURFACES OF RECTANGULAR PRISMS; EVALUATING FORMULÆ

The **surface** of a rectangular prism is simply the area of its six faces. These being rectangles, the areas of each may be found and added. Since certain dimensions of the rectangles comprising the lateral faces are the same, and since the two bases are the same, work in computing these areas may be saved.

Thus, in a rectangular prism whose base is 3 in. by 4 in. and whose height is 5 in., there are two rectangles each 3 in. by 5 in. and two 4 in. by 5 in. in the four lateral faces, and each base is 3 in. by 4 in.

Hence, the area of the total surface is

$$2 \times 3 \times 5 \text{ sq. in.} + 2 \times 4 \times 5 \text{ sq. in.} + 2 \times 3 \times 4 \text{ sq. in.} = 94 \text{ sq. in.}$$

It is more economical to consider that the four lateral faces, if placed side by side in one flat surface, would make a rectangle containing 5×14 sq. in., or 70 sq. in.; that is, the height was one dimension and the *perimeter* (distance around) of the base was the other.

1. If a and b are the dimensions of the base and p the perimeter of the base, then we have, when expressed as a formula, $p = a + b + a + b = 2a + 2b = 2(a + b)$.

Express in words what the formula means.

2. If L represents the lateral area and h the height, then as a formula we have

$$L = 2h(a + b).$$

Express in words what the formula means.

3. What is the perimeter of the base of a rectangular prism whose dimensions are 11 ft. and 15 ft.?

4. What is the lateral area of a rectangular prism whose height is 16 in. and whose base is 8 in. by 10 in.?

5. The total area of a prism is the sum of its lateral area and the two bases. Expressed as a formula, we have

$$S = L + 2B.$$

Express in words what the formula means.

6. Substituting the values of L and B, we have

$$S = 2h(a + b) + 2ab.$$

Express in words what the formula means.

7. Find the surface of a rectangular prism whose height (h) is 12 in. and the dimensions of whose bases (a and b) are 8 in. and 10 in., respectively.

8. In the formula $S = 2h(a + b) + 2ab$, 2, being a factor of the two *terms* to be added, may be divided out and used as a multiplier after $h(a + b)$ and ab are found and added. Thus, $2h(a + b) + 2ab = 2[h(a + b) + ab]$.

This is called **factoring** the expression. When numbers are substituted for the letters which they represent, it is called **evaluating the formula.**

9. Evaluate $2[h(a+b)+ab]$ when $a=5$, $b=8$, and $h=12$.

10. $h(a + b) + ab = ah + bh + ab$. This is called *removing the parenthesis.* Show with numbers for a, b, and h that the formula is true; that is, show that

$$4(3 + 5) + 3 \times 5 = 4 \times 3 + 4 \times 5 + 3 \times 5.$$

Evaluate the following formulæ:

11. $2[h(a + b) + ab]$ when $a = 6$, $b = 8$, and $h = 10$.

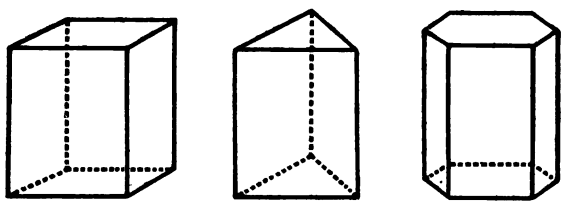
12. $ab + bh + ab$ when $a = 8$, $b = 10$, and $h = 12$.

The measurement of the surface of a prism is used here to make concrete and clear the meaning of a formula and how it expresses, in brief terms, a fact that would require a long explanation if words were used. These formulæ are not given, then, to help one to remember how to find the surface of a prism. A mental picture of the rectangles that compose the six faces is all that is needed.

Formulæ are used throughout mathematics to express, in brief and concise form, certain relations that exist. This will be seen as you make further progress in the study.

3. SURFACES AND VOLUMES OF ANY RIGHT PRISM

Any prism whose lateral faces are rectangles is a **right prism.** Only right prisms can be solved by elementary mathematics. A right prism is named from the shape of its



base. Those we have just studied were right rectangular prisms. When the base is a triangle, then they are right triangular prisms.

It was seen in our study of areas that the area of a rectangle was first found as a basis for other measurements, then all other areas were transformed into rectangles without changing their areas.

So with these right prisms, you can easily see that, if they were malleable, they might be pressed into rectangular prisms of the same height without changing the area of the bases.

Hence

$$V = Bh,$$

where V = number of cubic units in the volume,

B = number of square units in the base,

h = number of linear units in the height.

1. Find the volume of a triangular prism whose base contains 24 sq. in. and whose height is 9 in.

NOTE. — The written form should be 9×24 cu. in. $= 216$ cu. in. when the numbers are labeled, not the erroneous form 9 in. $\times$ 24 sq. in. $= 216$ cu. in. What principles of multiplication are violated in this erroneous form?

2. The bases of a prism 16 in. high are triangles whose bases and altitudes are respectively 12 in. and 8 in. Find the volume.

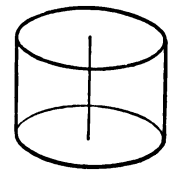
3. How many gallons will a V-shaped gutter discharge (flowing full) in 24 hours, if its depth is 9 inches and it is 20 inches across the top, and the water is flowing at the rate of 150 feet per minute? (Use $7\frac{1}{2}$ gallons per cubic foot.)

4. The cross section of an irrigation ditch is in the form of a trapezoid 5 ft. wide at the top, 3 ft. wide at the bottom, and 30 in. deep. When flowing full at the rate of 90 ft. per minute, how many cubic feet per hour are delivered?

5. When the wheat in a bin 12 ft. wide and 14 ft. long is piled 6 ft. deep along the back length of the bin and slopes to a depth of but 4 ft. along the front length, how many bushels are there, allowing .8 bu. per cubic foot?

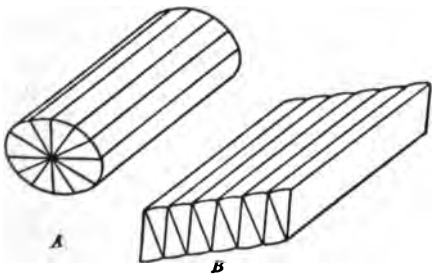
6. A swimming tank 30 ft. by 50 ft., with a sloping bottom, is filled to a depth of 3 ft. at one end, and 7 ft. at the other. Allowing $7\frac{1}{2}$ gallons per cubic foot, how much water was used?

4. THE SURFACE AND VOLUME OF A CYLINDER



The figure shows a right circular cylinder. Its surface consists of two circles, called **bases**, lying in parallel planes, and a curved surface called the **lateral surface**. The distance between the two bases is the height, or **altitude**, of the cylinder.

It is evident that the volume cannot be divided into cubes as in the case of a rectangular prism. But as shown in the figures *A* and *B*, a cylinder can be transformed into a solid very closely resembling a rectangular prism whose height is the same and whose base is unchanged in area. Hence, from this we may infer that



The number of cubic units in any right circular cylinder is equal to the product of the number of square units in the base and the number of linear units in the height.

Expressed as a formula, we have

$$V = Bh.$$

It will be observed that this is the same formula as that for prisms.

1. How many quarts will the can of an ice-cream freezer hold that is 8 inches across and 20 inches deep? (There are 57.75 cubic inches in a quart.)

2. A hot-water tank 5 ft. long and 12 in. in diameter will hold how many gallons? (231 cu. in. = 1 gal.)

3. The piston of a pump is 6 inches in diameter and makes a 12-inch stroke. How many gallons of water will it deliver per hour, making 30 strokes per minute in each direction, but delivering water only on the forward stroke?

4. A pipe 2 inches in diameter will deliver how many times as much water in a given time as one but $\frac{1}{2}$ inch in diameter, the water in both flowing at the same velocity?

5. How many tons of silage will a cylindrical silo 14 ft. in diameter and 25 ft. high hold, allowing 50 cu. ft. to the ton?

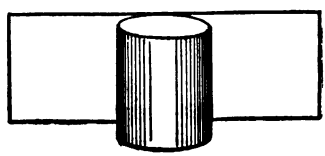
6. A man who has a herd of 60 cows fills two silos, each 16 ft. in diameter and 25 ft. high. How long will it last if he uses 40 lb. per day for each cow? (Use 50 cu. ft. per ton.)

7. Allowing 4.2 cu. ft. per barrel, how many barrels will a cistern hold that is 8 ft. in diameter and 12 ft. deep?

8. The cylindrical tank of a sprinkling car used in sprinkling streets is 4 ft. in diameter and 20 ft. long. How many gallons will it hold?

The Surface of a Cylinder

By taking a piece of paper and rolling it about a right circular cylinder, it is seen that the lateral area is the same as that of a rectangle whose dimensions are the circumference of the cylinder and its height; that is,



The number of square units in the lateral area of a right circular cylinder is the product of the number of linear units in its circumference and the number in the altitude.

Expressed as a formula, this is

$$L = hc.$$

Since $c = \pi d$, $L = \pi hd$.

Thus the lateral area of a cylinder 8 in. high and 4 in. in diameter is $3.1416 \times 8 \times 4$ sq. in.

1. How many square inches of sheet iron in a stove pipe 6 in. in diameter and 8 ft. long?

2. How many square feet in the walls and bottom of a cylindrical cistern 8 ft. in diameter and 12 ft. deep?

3. A room is heated by eight 2-inch (outer diameter) pipes each 16 ft. long, conveying the steam. Find the number of square feet of radiation in the room.

4. If your schoolhouse is heated by pipes, compute the amount of radiation in various rooms.

5. To make an ash can 20 inches in diameter and 32 inches high requires how many square feet of galvanized iron, not including a cover?

6. How much will it cost to paint the outside of a silo 16 ft. in diameter and 30 ft. high at $1.90 per 100 sq. ft., not including the roof?

CHAPTER XI

SUPPLEMENTARY DRILLS IN COMPUTATION

Since accuracy and a fair degree of rapidity in computation are essential to success in mathematical work, this chapter is added to give practice in pure drill work in computation whenever it seems wise to take the attention from the problems and direct it to such drill work in order to develop greater skill. It is not intended that it be taken at the end of the course, but it is to be used along during the term, according to the needs of the class.

Add and check without rewriting:

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
48	53	96	81	74	38	29	61	46	85
56	92	81	46	59	86	97	58	39	76
92	75	49	86	97	93	85	79	86	57
57	96	85	93	48	54	93	86	54	61
64	82	94	76	87	78	39	21	67	85
59	76	85	98	19	28	46	75	42	31
86	52	28	31	46	35	48	96	38	74
92	84	76	98	53	96	89	75	58	67
88	92	59	86	75	57	63	91	84	76
83	48	56	92	81	78	96	47	59	68
96	74	63	26	38	19	23	58	43	37
78	96	98	72	74	46	79	65	84	86
57	82	75	85	93	83	82	73	27	29
65	49	69	46	27	91	96	92	19	85

Add and check without rewriting:

1.	2.	3.	4.	5.	6.	7.	8.
327	869	521	674	536	913	483	696
586	392	468	715	861	392	746	528
764	926	247	693	836	928	463	751
682	587	837	768	432	765	926	847
579	168	394	624	568	257	385	546
768	793	684	765	893	721	964	397
681	564	375	496	379	846	378	765
346	278	563	613	804	732	982	346
587	693	764	684	932	761	297	853

9.	10.	11.	12.	13.	14.	15.	16.
846	937	693	768	597	816	738	896
795	846	729	857	926	798	693	921
516	728	683	947	765	583	786	695
897	895	926	784	829	695	847	796
785	584	785	926	887	968	785	579
568	794	826	518	469	723	816	926
826	785	953	847	768	954	731	892
596	854	576	954	387	769	598	217
769	347	893	784	936	845	739	768

17.	18.	19.	20.	21.	22.	23.	24.
725	957	698	819	789	695	727	824
998	896	921	763	892	926	847	968
834	927	968	956	748	695	896	789
792	819	782	597	684	793	579	647
986	839	546	876	928	893	767	986
824	768	921	796	864	923	869	765
773	865	782	568	693	845	754	896
831	294	359	627	485	638	529	274
968	827	596	792	863	924	410	680

*Add without checking for **six minutes**. **Keep a record** of the number attempted and the per cent of accuracy:*

1.	2.	3.	4.	5.	6.	7.	8.
396	847	561	738	569	784	398	594
565	684	938	563	847	961	768	839
786	957	863	984	768	395	786	392
695	784	398	767	829	568	639	754
837	569	837	694	348	783	984	567
786	957	596	875	967	831	765	981
928	716	625	719	391	568	697	564
758	426	591	843	728	689	842	753

9.	10.	11.	12.	13.	14.	15.	16.
398	576	841	728	564	692	841	726
925	685	778	964	358	965	786	958
569	791	847	678	916	834	976	829
732	987	696	583	648	793	845	694
684	516	832	196	247	385	196	487
819	683	795	628	785	632	875	946
784	538	623	682	561	706	721	806
629	247	594	947	819	390	675	758

17.	18.	19.	20.	21.	22.	23.	24.
768	894	687	819	689	578	619	589
589	648	916	796	874	916	807	960
826	984	696	837	592	678	569	853
602	750	983	842	906	816	703	960
586	974	683	859	658	948	846	759
875	707	530	816	785	963	786	926
763	910	808	730	607	730	685	367
841	356	746	843	836	845	709	580

Subtract and check without rewriting:

1.	2.	3.	4.
96,840,360	76,903,761	50,913,546	81,392,047
78,963,745	68,195,684	46,397,168	56,598,354
5.	**6.**	**7.**	**8.**
84,068,053	90,647,380	79,240,301	84,056,049
38,071,561	75,819,568	34,726,432	63,768,153
9.	**10.**	**11.**	**12.**
102,694,027	112,301,560	103,740,531	112,896,307
84,763,746	57,860,938	96,348,629	89,647,963
13.	**14.**	**15.**	**16.**
90,678,006	87,340,631	92,006,395	90,304,581
76,039,507	50,963,584	70,693,748	65,408,396
17.	**18.**	**19.**	**20.**
81,036,579	76,301,946	85,096,300	91,340,961
76,307,628	50,932,981	30,963,748	38,576,248
21.	**22.**	**23.**	**24.**
71,036,580	69,504,936	80,751,906	53,098,125
48,369,186	37,416,184	43,186,247	16,829,348
25.	**26.**	**27.**	**28.**
62,147,098	84,106,340	61,096,352	81,764,316
28,206,938	67,461,738	42,327,106	52,798,149
29.	**30.**	**31.**	**32.**
50,756,195	89,607,301	59,760,828	84,091,396
19,827,432	21,692,840	29,832,645	21,764,138
33.	**34.**	**35.**	**36.**
106,834,916	135,068,201	138,906,720	126,070,341
91,961,347	89,762,564	81,268,142	91,176,827

Subtract without checking for four minutes. Keep a record of the number attempted and the per cent of accuracy:

1.	2.	3.	4.
87,936,048	92,839,046	81,736,841	90,361,784
54,391,821	17,684,968	23,748,685	36,725,691
5.	**6.**	**7.**	**8.**
80,364,298	89,076,348	59,806,784	96,780,361
28,138,516	26,381,926	31,642,516	47,906,248
9.	**10.**	**11.**	**12.**
71,036,984	52,903,781	61,530,835	72,036,981
52,928,391	27,386,395	28,736,927	48,329,874
13.	**14.**	**15.**	**16.**
90,346,126	69,840,361	84,201,396	79,207,825
70,692,185	21,896,520	65,296,138	24,836,916
17.	**18.**	**19.**	**20.**
76,087,329	81,506,742	95,807,896	89,932,480
57,392,145	26,384,216	68,892,247	51,384,526
21.	**22.**	**23.**	**24.**
51,604,527	81,403,908	75,038,249	63,920,163
28,795,286	54,296,209	38,162,741	21,697,295
25.	**26.**	**27.**	**28.**
70,986,251	84,037,965	39,416,048	51,048,964
42,798,526	76,854,378	16,821,934	26,856,785
29.	**30.**	**31.**	**32.**
69,061,786	82,906,783	92,260,576	89,740,365
39,826,293	52,987,622	65,843,648	49,826,732
33.	**34.**	**35.**	**36.**
85,906,384	79,082,168	71,608,728	59,893,267
16,893,846	19,896,329	20,729,153	16,998,428

Multiply and check:

1. 47×6825.	25. 209×5268.	49. 569×897.
2. 53×7968.	26. 708×6781.	50. 976×485.
3. 68×8496.	27. 605×8196.	51. 827×694.
4. 29×7385.	28. 807×7954.	52. 786×925.
5. 46×6439.	29. 803×6832.	53. 695×847.
6. 85×8654.	30. 790×7391.	54. 783×926.
7. 73×7689.	31. 810×8462.	55. 629×875.
8. 92×5291.	32. 709×6374.	56. 918×796.
9. 81×6782.	33. 408×7296.	57. 891×657.
10. 49×9645.	34. 830×9254.	58. 683×967.
11. 86×8547.	35. 920×7563.	59. 524×968.
12. 54×6389.	36. 805×6483.	60. 719×854.
13. 79×7195.	37. 503×7826.	61. 692×718.
14. 86×9342.	38. 730×5467.	62. 816×793.
15. 37×8561.	39. 901×7428.	63. 974×681.
16. 68×9257.	40. 605×9184.	64. 769×975.
17. 94×8563.	41. 810×8927.	65. 854×946.
18. 59×9128.	42. 902×7631.	66. 769×815.
19. 78×7932.	43. 670×5468.	67. 865×793.
20. 67×6983.	44. 706×9237.	68. 619×658.
21. 83×5487.	45. 504×8167.	69. 927×574.
22. 91×9615.	46. 307×9068.	70. 836×591.
23. 87×8376.	47. 650×7396.	71. 918×654.
24. 76×6859.	48. 820×5782.	72. 837×695.

Without checking, see how many of the first two columns you can multiply in eight minutes. Keep a record of the number attempted and the per cent of accuracy.

Divide and check:

1. 65,642 ÷ 83.
2. 74,967 ÷ 94.
3. 81,365 ÷ 96.
4. 48,763 ÷ 73.
5. 57,607 ÷ 84.
6. 64,076 ÷ 92.
7. 80,369 ÷ 87.
8. 76,173 ÷ 85.
9. 34,628 ÷ 67.
10. 51,673 ÷ 76.
11. 59,638 ÷ 87.
12. 61,096 ÷ 95.
13. 43,769 ÷ 76.
14. 39,847 ÷ 85.
15. 29,647 ÷ 56.
16. 31,208 ÷ 64.
17. 29,846 ÷ 74.
18. 33,169 ÷ 86.
19. 37,026 ÷ 96.
20. 55,167 ÷ 68.
21. 65,362 ÷ 87.
22. 73,680 ÷ 95.
23. 82,197 ÷ 93.
24. 63,972 ÷ 78.
25. 57,216 ÷ 84.
26. 76,821 ÷ 138.
27. 65,763 ÷ 176.
28. 87,432 ÷ 169.
29. 93,128 ÷ 147.
30. 67,865 ÷ 163.
31. 59,764 ÷ 175.
32. 84,306 ÷ 148.
33. 79,276 ÷ 157.
34. 86,643 ÷ 276.
35. 91,765 ÷ 283.
36. 87,234 ÷ 267.

Without checking, score the number attempted in eight minutes and the per cent of accuracy:

37. 37,643 ÷ 48.
38. 30,956 ÷ 37.
39. 42,851 ÷ 67.
40. 53,961 ÷ 87.
41. 46,304 ÷ 96
42. 25,321 ÷ 84.
43. 26,075 ÷ 86.
44. 33,153 ÷ 67.
45. 29,031 ÷ 73.
46. 46,021 ÷ 94.
47. 32,963 ÷ 83.
48. 57,016 ÷ 78.
49. 27,963 ÷ 94.
50. 36,785 ÷ 43.
51. 54,139 ÷ 64.
52. 49,165 ÷ 76.
53. 38,160 ÷ 95.
54. 43,648 ÷ 64.
55. 82,163 ÷ 96.
56. 73,147 ÷ 83.
57. 65,042 ÷ 86.
58. 37,916 ÷ 47.
59. 25,286 ÷ 64.
60. 23,096 ÷ 74.
61. 43,689 ÷ 72.
62. 57,695 ÷ 76.
63. 74,163 ÷ 86.
64. 67,031 ÷ 83.
65. 75,697 ÷ 93.
66. 83,146 ÷ 96.
67. 50,347 ÷ 74.
68. 58,130 ÷ 85.
69. 37,961 ÷ 48.
70. 38,146 ÷ 94.
71. 36,780 ÷ 76.
72. 29,130 ÷ 46.
73. 31,460 ÷ 53.
74. 38,152 ÷ 96.
75. 49,276 ÷ 64.

Add and check:

1.	2.	3.	4.	5.	6.
$345\frac{1}{2}$	$176\frac{1}{8}$	$847\frac{2}{3}$	$743\frac{2}{3}$	$196\frac{1}{4}$	$841\frac{1}{3}$
$789\frac{3}{4}$	$289\frac{5}{6}$	$692\frac{5}{9}$	$654\frac{1}{5}$	$781\frac{3}{8}$	$761\frac{5}{6}$
$267\frac{5}{8}$	$743\frac{1}{2}$	$786\frac{1}{2}$	$936\frac{3}{5}$	$643\frac{1}{2}$	$872\frac{1}{2}$
$535\frac{3}{4}$	$865\frac{3}{4}$	$638\frac{5}{6}$	$257\frac{2}{3}$	$757\frac{1}{8}$	$961\frac{1}{3}$
$641\frac{7}{8}$	$971\frac{1}{3}$	$946\frac{2}{9}$	$764\frac{1}{6}$	$976\frac{3}{4}$	$763\frac{7}{12}$

7.	8.	9.	10.	11.	12.
$834\frac{4}{5}$	$728\frac{1}{8}$	$196\frac{2}{3}$	$765\frac{3}{4}$	$841\frac{5}{6}$	$416\frac{7}{16}$
$765\frac{3}{8}$	$563\frac{3}{4}$	$783\frac{5}{6}$	$641\frac{2}{3}$	$348\frac{2}{9}$	$548\frac{1}{2}$
$361\frac{1}{2}$	$681\frac{1}{2}$	$574\frac{1}{2}$	$768\frac{1}{2}$	$117\frac{1}{2}$	$657\frac{3}{4}$
$736\frac{5}{6}$	$748\frac{3}{4}$	$928\frac{3}{4}$	$564\frac{1}{4}$	$846\frac{3}{8}$	$721\frac{5}{8}$
$841\frac{2}{3}$	$563\frac{5}{8}$	$761\frac{1}{3}$	$687\frac{5}{6}$	$317\frac{5}{9}$	$946\frac{3}{4}$

13. $\frac{4}{5}+\frac{3}{4}+\frac{1}{2}+\frac{7}{10}+\frac{2}{5}$.
14. $\frac{2}{7}+\frac{1}{3}+\frac{4}{21}+\frac{2}{3}+\frac{1}{2}$.
15. $\frac{2}{3}+\frac{2}{3}+\frac{5}{6}+\frac{1}{2}+\frac{3}{4}$.
16. $\frac{7}{8}+\frac{5}{16}+\frac{1}{2}+\frac{3}{4}+\frac{7}{16}+\frac{1}{2}$.
17. $\frac{2}{3}+\frac{4}{5}+\frac{5}{6}+\frac{1}{3}+\frac{1}{2}+\frac{2}{5}$.
18. $\frac{5}{12}+\frac{2}{3}+\frac{5}{9}+\frac{3}{4}+\frac{1}{2}+\frac{5}{6}$.

Subtract and check:

19.	20.	21.	22.	23.	24.
$36\frac{2}{3}$	$48\frac{3}{4}$	$54\frac{5}{6}$	$84\frac{3}{4}$	$96\frac{5}{8}$	$43\frac{5}{9}$
$17\frac{1}{2}$	$19\frac{1}{8}$	$27\frac{2}{3}$	$26\frac{1}{2}$	$38\frac{1}{2}$	$16\frac{1}{3}$

25.	26.	27.	28.	29.	30.
$42\frac{1}{3}$	$53\frac{1}{4}$	$38\frac{1}{6}$	$54\frac{1}{4}$	$38\frac{1}{6}$	$53\frac{1}{8}$
$26\frac{1}{2}$	$16\frac{3}{8}$	$19\frac{2}{3}$	$16\frac{3}{8}$	$27\frac{1}{2}$	$46\frac{3}{4}$

31.	32	33.	34.	35.	36.
48	54	67	84	91	82
$16\frac{2}{3}$	$19\frac{3}{4}$	$29\frac{5}{6}$	$36\frac{3}{8}$	$25\frac{4}{5}$	$16\frac{7}{8}$

37. $\frac{5}{8}-\frac{1}{4}$.
38. $\frac{13}{16}-\frac{3}{4}$.
39. $\frac{11}{12}-\frac{5}{6}$.
40. $\frac{8}{9}-\frac{2}{3}$.
41. $\frac{5}{6}-\frac{3}{4}$.
42. $\frac{2}{5}-\frac{1}{3}$.

Multiply and check:

1. $48 \times 346\frac{2}{3}$.
2. $56 \times 784\frac{3}{4}$.
3. $74 \times 567\frac{2}{5}$.
4. $86 \times 643\frac{5}{7}$.
5. $92 \times 756\frac{3}{4}$.
6. $86 \times 943\frac{4}{5}$.
7. $87 \times 648\frac{7}{8}$.
8. $93 \times 726\frac{4}{5}$.
9. $81 \times 654\frac{3}{5}$.
10. $76 \times 893\frac{4}{5}$.
11. $81 \times 769\frac{2}{7}$.
12. $64 \times 846\frac{3}{5}$.
13. $96 \times 837\frac{2}{5}$.
14. $87 \times 936\frac{7}{8}$.
15. $92 \times 861\frac{2}{3}$.
16. $63 \times 798\frac{3}{4}$.
17. $84 \times 689\frac{7}{9}$.
18. $65 \times 693\frac{1}{9}$.
19. $84 \times 569\frac{5}{7}$.
20. $39 \times 764\frac{4}{7}$.
21. $52 \times 896\frac{5}{6}$.
22. $42 \times 768\frac{3}{8}$.
23. $86 \times 539\frac{7}{8}$.
24. $91 \times 634\frac{2}{5}$.
25. $86 \times 728\frac{4}{7}$.
26. $93 \times 864\frac{3}{8}$.
27. $91 \times 376\frac{4}{5}$.

28. $\frac{3}{4} \times \frac{12}{18}$.
29. $\frac{2}{5} \times \frac{15}{16}$.
30. $\frac{3}{4} \times \frac{7}{9}$.
31. $\frac{5}{6} \times \frac{9}{10}$.
32. $\frac{7}{8} \times \frac{12}{13}$.
33. $\frac{5}{6} \times \frac{9}{20}$.
34. $\frac{7}{8} \times \frac{16}{21}$.
35. $\frac{4}{5} \times \frac{15}{16}$.
36. $\frac{8}{9} \times \frac{15}{16}$.
37. $\frac{7}{8} \times \frac{4}{21}$.
38. $\frac{2}{9} \times \frac{15}{22}$.
39. $\frac{3}{8} \times \frac{16}{27}$.
40. $\frac{5}{6} \times \frac{24}{25}$.
41. $\frac{3}{4} \times \frac{20}{27}$.
42. $\frac{5}{6} \times \frac{18}{25}$.
43. $\frac{7}{9} \times \frac{27}{28}$.

44. $2\frac{1}{2} \times 385$.
45. $3\frac{2}{3} \times 768$.
46. $4\frac{3}{4} \times 916$.
47. $5\frac{2}{5} \times 864$.
48. $6\frac{1}{4} \times 965$.
49. $7\frac{2}{5} \times 863$.
50. $3\frac{3}{4} \times 684$.
51. $5\frac{3}{7} \times 693$.
52. $4\frac{2}{3} \times 892$.
53. $3\frac{5}{6} \times 765$.
54. $4\frac{3}{4} \times 692$.
55. $5\frac{1}{2} \times 937$.
56. $3\frac{2}{3} \times 730$.
57. $4\frac{3}{4} \times 465$.
58. $5\frac{2}{3} \times 598$.
59. $6\frac{2}{3} \times 643$.
60. $7\frac{3}{6} \times 893$.
61. $3\frac{2}{5} \times 936$.

62. $3\frac{1}{2} \times 5\frac{2}{3}$.
63. $8\frac{1}{2} \times 2\frac{3}{4}$.
64. $7\frac{1}{3} \times 3\frac{1}{2}$.
65. $5\frac{3}{4} \times 4\frac{1}{3}$.
66. $6\frac{2}{3} \times 5\frac{1}{4}$.
67. $7\frac{1}{2} \times 2\frac{3}{4}$.
68. $4\frac{2}{5} \times 3\frac{1}{2}$.
69. $3\frac{2}{3} \times 2\frac{7}{8}$.
70. $5\frac{1}{2} \times 3\frac{2}{3}$.
71. $6\frac{1}{4} \times 5\frac{3}{4}$.
72. $7\frac{1}{2} \times 8\frac{1}{3}$.
73. $6\frac{1}{4} \times 3\frac{1}{2}$.
74. $8\frac{2}{3} \times 3\frac{1}{3}$.
75. $5\frac{7}{8} \times 4\frac{1}{2}$.
76. $6\frac{2}{3} \times 5\frac{1}{4}$.

77.	78.	79.	80.	81.
346	$324\frac{2}{5}$	$526\frac{2}{3}$	$624\frac{1}{2}$	$536\frac{2}{3}$
$26\frac{2}{3}$	38	47	$75\frac{2}{3}$	$48\frac{1}{2}$

Divide and check:

1. $\frac{3}{4} \div 5$.	11. $2\frac{1}{2} \div 3$.	21. $\frac{3}{4} \div \frac{2}{3}$.	31. $1\frac{1}{2} \div 2\frac{2}{3}$.
2. $\frac{2}{3} \div 4$.	12. $3\frac{1}{3} \div 2$.	22. $\frac{5}{6} \div \frac{3}{4}$.	32. $3\frac{1}{2} \div 1\frac{3}{4}$.
3. $\frac{5}{6} \div 7$.	13. $4\frac{1}{5} \div 3$.	23. $\frac{1}{2} \div \frac{2}{3}$.	33. $5\frac{2}{3} \div 2\frac{1}{2}$.
4. $\frac{1}{2} \div 3$.	14. $2\frac{2}{3} \div 5$.	24. $\frac{5}{8} \div \frac{3}{4}$.	34. $6\frac{1}{4} \div 5\frac{1}{3}$.
5. $\frac{5}{6} \div 2$.	15. $4\frac{1}{3} \div 6$.	25. $\frac{2}{9} \div \frac{5}{6}$.	35. $8\frac{2}{3} \div 3\frac{5}{6}$.
6. $\frac{3}{7} \div 5$.	16. $3\frac{3}{4} \div 7$.	26. $\frac{3}{8} \div \frac{4}{5}$.	36. $9\frac{1}{3} \div 4\frac{5}{8}$.
7. $\frac{4}{5} \div 8$.	17. $5\frac{1}{2} \div 8$.	27. $\frac{1}{2} \div \frac{3}{4}$.	37. $7\frac{1}{2} \div 5\frac{1}{3}$.
8. $\frac{7}{8} \div 3$.	18. $6\frac{3}{4} \div 4$.	28. $\frac{3}{4} \div \frac{1}{2}$.	38. $6\frac{3}{4} \div 2\frac{1}{3}$.
9. $\frac{5}{6} \div 10$.	19. $7\frac{1}{2} \div 6$.	29. $\frac{7}{8} \div \frac{2}{3}$.	39. $3\frac{1}{4} \div 5\frac{1}{2}$.
10. $\frac{6}{7} \div 12$.	20. $8\frac{2}{3} \div 5$.	30. $\frac{5}{6} \div \frac{7}{9}$.	40. $1\frac{7}{8} \div 7\frac{2}{3}$.

41. $346\frac{1}{2} \div 8$.	46. $1346\frac{3}{8} \div 9$.	51. $7693\frac{5}{8} \div 5$.
42. $763\frac{2}{3} \div 9$.	47. $2763\frac{3}{5} \div 8$.	52. $6729\frac{3}{4} \div 6$.
43. $576\frac{3}{4} \div 7$.	48. $7426\frac{5}{6} \div 5$.	53. $7168\frac{3}{5} \div 9$.
44. $892\frac{2}{3} \div 5$.	49. $6342\frac{2}{3} \div 8$.	54. $4211\frac{7}{8} \div 7$.
45. $716\frac{5}{6} \div 8$.	50. $2693\frac{4}{5} \div 7$.	55. $6429\frac{3}{5} \div 9$.

Add and check:

56.	57.	58.	59.	60.
39.46	21.165	3.96	8.175	39.16
8.245	7.69	18.153	26.28	3.167
19.462	29.384	9.26	8.348	19.26
7.523	7.892	16.384	19.76	7.385
29.46	83.94	93.81	47.563	94.17
42.156	75.69	88.92	9.46	8.379
9.81	7.436	9.365	18.528	36.84
42.963	57.975	36.84	96.83	9.684
57.389	86.97	42.368	9.267	48.16
8.962	7.834	9.681	8.093	7.068
29.309	15.87	46.093	30.68	15.709

Subtract and check:

1.	2.	3.	4.	5.	6.
26.875	31.297	56.028	40.697	51.608	42.876
17.096	13.729	28.349	16.875	26.849	19.397
7.	**8.**	**9.**	**10.**	**11.**	**12.**
168.29	97.068	34.062	384.48	216.75	96.308
96.382	16.797	9.375	96.843	87.247	27.329
13.	**14.**	**15.**	**16.**	**17.**	**18.**
203.42	91.075	106.84	309.241	670.36	281.047
92.628	13.283	87.468	19.84	316.486	19.38
19.	**20.**	**21.**	**22.**	**23.**	**24.**
176.3	801.43	360.98	175.08	301.97	841.096
81.543	72.967	16.843	6.297	9.065	17.93
25.	**26.**	**27.**	**28.**	**29.**	**30.**
201.6	29.635	168.9	314.09	216.81	340.16
9.875	19.78	4.364	2.386	197.625	7.846

Multiply and check:

31.	3.46×89.2.	**44.**	$.026 \times 9.38$.	**57.**	$.08 \times 3.765$.
32.	5.03×6.04.	**45.**	$.092 \times .931$.	**58.**	$.7 \times 2.0095$.
33.	7.31×92.8.	**46.**	$.085 \times .096$.	**59.**	$.03 \times 1.906$.
34.	6.03×92.5.	**47.**	$.175 \times 3.02$.	**60.**	$.025 \times 6.304$.
35.	76.1×3.47.	**48.**	$.081 \times 40.6$.	**61.**	$.106 \times .009$.
36.	$.863 \times 785$.	**49.**	$.095 \times 6.05$.	**62.**	$.005 \times .063$.
37.	$3.64 \times .832$.	**50.**	$.008 \times 42.3$.	**63.**	$.09 \times 3.026$.
38.	$.265 \times .304$.	**51.**	1.09×63.5.	**64.**	$.5 \times 64.382$.
39.	1.98×7.63.	**52.**	20.6×30.4.	**65.**	$7.2 \times .0092$.
40.	34.2×9.65.	**53.**	3.08×1.06.	**66.**	$.008 \times 9.07$.
41.	$3.68 \times .245$.	**54.**	$40.2 \times .083$.	**67.**	1.09×7.08.
42.	$378 \times .936$.	**55.**	5.06×1.09.	**68.**	30.4×9.02.
43.	7.83×7.65.	**56.**	$30.7 \times .106$.	**69.**	$.406 \times 80.3$.

Divide and check:

1. $36.95 \div 84$.
2. $7.963 \div 46$.
3. $836.7 \div 94$.
4. $6.875 \div 48$.
5. $36.24 \div 76$.
6. $9.175 \div 56$.
7. $13.284 \div 38$.
8. $264.93 \div 87$.
9. $4.685 \div 58$.
10. $103.96 \div 43$.
11. $28.645 \div 9.8$.
12. $37.692 \div 8.4$.
13. $176.35 \div 7.6$.
14. $8.976 \div .53$.
15. $92.465 \div .78$.
16. $362.97 \div .92$.
17. $84.362 \div 7.9$.
18. $6.4675 \div 8.3$.
19. $96.406 \div .92$.
20. $384.08 \div .65$.
21. $.0296 \div .132$.
22. $.906 \div 1.76$.
23. $3.84 \div .276$.
24. $19.3 \div 3.84$.
25. $246 \div 19.3$.
26. $.084 \div 26.3$.
27. $.175 \div 9.36$.
28. $92.4 \div .084$.
29. $6.32 \div .906$.
30. $17.35 \div .084$.

Find:

31. 5% of 378.
32. 6% of 96.2.
33. 7% of 1.75.
34. $3\frac{1}{2}$% of 280.
35. $5\frac{1}{2}$% of 460.
36. $6\frac{1}{4}$% of 390.
37. $7\frac{1}{4}$% of 920.
38. $8\frac{1}{2}$% of 780.
39. 32% of 96.
40. 84% of 45.
41. 96% of 8.4.
42. 45% of 6.7.
43. 53% of 96.
44. 72% of 8.4.
45. 65% of 9.6.
46. 38% of .95.
47. 3.25% of 800.
48. 6.34% of 900.
49. 12.3% of 760.
50. 15.4% of 860.
51. 4.28% of 900.
52. 5.09% of 1600.
53. 6.23% of 2400.
54. 8.06% of 3200.

Find the per cent:

55. 48 of 125.
56. 36 of 287.
57. 92 of 375.
58. 84 of 178.
59. 96 of 225.
60. 80 of 365.
61. 72 of 169.
62. 365 of 128.
63. 294 of 169.
64. 306 of 285.
65. 430 of 245.
66. 560 of 175.
67. 480 of 935.
68. 640 of 865.
69. 9.3 of 13.6.
70. 12.4 of 38.5.
71. 8.6 of 145.
72. 7.2 of 926.
73. 93 of 81.4.
74. .86 of 3.26.
75. 1.48 of 5.6.

TABLES OF MEASURES

Linear Measure

12 inches (in.) = 1 foot (ft.)
3 feet = 1 yard (yd.)
16½ feet = 1 rod (rd.)
320 rods = 1 mile (mi.)
1 mile = 1760 yards = 5280 feet

Square Measure

144 square inches (sq. in.) = 1 square foot (sq. ft.)
9 square feet = 1 square yard (sq. yd.)
272¼ square feet = 1 square rod (sq. rd.)
160 square rods = 1 acre (A.)
1 square mile (sq. mi.) = 640 acres
1 acre = 43,560 square feet

Cubic Measure

1728 cubic inches (cu. in.) = 1 cubic foot (cu. ft.)
27 cubic feet = 1 cubic yard (cu. yd.)
128 cubic feet = 1 cord (cd.)

Liquid Measure

2 pints (pt.) = 1 quart (qt.)
4 quarts = 1 gallon (gal.)
1 gallon = 231 cubic inches

Dry Measure

2 pints = 1 quart
8 quarts = 1 peck (pk.)
4 pecks = 1 bushel (bu.)
1 bushel = 2150.42 cubic inches

Avoirdupois Weight

16 ounces (oz.) = 1 pound (lb.)
2000 pounds = 1 ton (T.)

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8. 4007.
10. 232.50.
11. 311.36.
12. 195.40.
13. 267.79.
14. 242.83.
15. 284.67.

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2. 77,794.
3. 83,505.
4. 77,370.
5. 81,882.
6. 70,815.

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3. $1\frac{3}{5}$.
4. 2.
5. $1\frac{1}{12}$.
6. $1\frac{3}{4}$.
7. $1\frac{5}{16}$.
8. $1\frac{1}{2}$.
9. $1\frac{3}{8}$.
10. $1\frac{1}{12}$.
11. $1\frac{5}{8}$.
12. $2\frac{1}{16}$.
13. $1\frac{11}{15}$.
14. $1\frac{13}{15}$.
15. $123\frac{1}{2}$.
16. $149\frac{1}{2}$.
17. 170.
18. $144\frac{1}{2}$.
19. $147\frac{1}{4}$.
20. $173\frac{3}{4}$.
21. $172\frac{7}{8}$.
22. $145\frac{1}{4}$.
23. $188\frac{1}{10}$.
24. $113\frac{1}{8}$.
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9. 41712.
10. 65699.
11. 61577.
12. 27846.
13. 22652.
14. 13826.
15. 145.88.
16. 343.62.
17. 231.87.
18. 513.81.
19. 175.46.
20. 113.58.
21. $148\frac{5}{12}$.
22. $87\frac{7}{12}$.
23. $106\frac{3}{5}$.
24. $106\frac{7}{8}$.
25. $161\frac{3}{5}$.
26. $160\frac{1}{2}$.
27. $84\frac{3}{5}$.
28. $381\frac{3}{4}$.
29. $234\frac{1}{4}$.
30. $471\frac{5}{8}$.
31. $563\frac{5}{8}$.
32. $803\frac{3}{8}$.
33. $264\frac{7}{9}$.
34. $507\frac{3}{4}$.
35. $34\frac{1}{2}$.

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1. 249,095.
2. 426,408.
3. 338,954.
4. 399,954.
5. 275,253.
6. 637,940.
7. 387,143.
8. 770,764.
9. 452,298.
10. 321,216.
11. 237,312.
12. 598,968.
14. 10,035.
15. $26,014\frac{1}{4}$.
16. $61,015\frac{1}{4}$.
17. $13,181\frac{1}{4}$.
18. $17,341\frac{3}{4}$.
19. $32,986\frac{3}{4}$.
20. $54,646\frac{3}{4}$.
21. 63.46.
22. 487.76.
23. 6259.5.
24. 645.96.
25. 307.88.
26. 905.22.
27. 4998.5.
28. 462.24.
29. 823.44.

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1. $723\frac{3}{4}$.
2. $522\frac{3}{4}$.
3. $802\frac{1}{2}$.
4. $286\frac{1}{2}$.
5. $2551\frac{1}{2}$.
6. 3588.
7. $6173\frac{1}{4}$.
8. $4758\frac{1}{2}$.
9. 2345.
10. $3257\frac{1}{2}$.

11. $4153\frac{4}{5}$.
12. $2452\frac{1}{2}$.

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1. $\frac{9}{17}$.
2. $\frac{3}{5}$.
3. $\frac{3}{5}$.
4. $\frac{3}{4}$.
5. $\frac{2}{3}$.
6. $\frac{2}{3}$.
7. $\frac{1}{4}$.
8. $\frac{1}{5}$.
9. $\frac{1}{3}$.
10. $\frac{11}{35}$.
11. $\frac{2}{3}$.
12. $\frac{11}{35}$.

1. 27.68.
2. 7.875.
3. 43.61.
4. 3.72.
5. 38.15.
6. 50.92.
7. 4.224.
8. 36.594.
9. 12.576.
10. 54.891.
11. 81.408.
12. 673.92.
13. 81.855.
14. 73.108.
15. 71.136.

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1. .25.
2. .45.
3. .76.
4. .95.
5. .48.
6. .045.
7. .125.
8. .0625.
9. .1575.
10. .205.
11. .942.
12. .163.
13. .236.
14. .0345.
15. .0612.
16. 1.25.
17. 1.4.
18. 2.5.
19. 1.65.
20. 2.75.
21. 46.
22. 69.12.
23. 48.15.
24. 45.84.
25. 47.95.
26. 29.01.
27. 27.3.
28. 25.92.
29. 59.33.
30. 10.8.
31. 24.765.
32. 69.44.
33. 14.88.
34. 47.725.
35. 46.102.
36. 40.05.
37. 14.95.
38. 35.36.

Page 13

1. 5941; 68 rem.
2. 8473; 13 rem.
3. 8677; 61 rem.
4. 6707; 40 rem.
5. 8621; 14 rem.
6. 7503; 67 rem.
7. 6561; 41 rem.
8. 8181; 38 rem.
9. 6940; 33 rem.
10. 7627; 29 rem.
11. 7823; 31 rem.
12. 7749; 92 rem.

Pages 14–15

1. $1\frac{7}{8}$.
2. $\frac{14}{15}$.
3. $\frac{8}{27}$.
4. $1\frac{1}{20}$.
5. $\frac{7}{8}$.
6. $1\frac{1}{3}$.
7. $1\frac{1}{20}$.
8. $\frac{5}{6}$.
9. $2\frac{3}{16}$.
10. $2\frac{2}{3}$.
11. $1\frac{5}{16}$.
12. $2\frac{2}{3}$.
13. $\frac{9}{20}$.
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17. $\frac{8}{33}$.
18. $\frac{3}{20}$.
19. $\frac{3}{34}$.
20. $\frac{4}{75}$.
21. $\frac{3}{64}$.
22. $\frac{4}{81}$.
23. $\frac{3}{44}$.
24. $\frac{1}{45}$.
26. 2.
27. $2\frac{1}{2}$.
28. 2.
29. $3\frac{3}{4}$.
30. $2\frac{10}{33}$.
31. $1\frac{17}{33}$.
32. $3\frac{1}{33}$.
33. $2\frac{2}{35}$.
34. $2\frac{1}{3}$.
36. $49\frac{7}{11}$.
37. $82\frac{14}{11}$.
38. $62\frac{7}{12}$.
39. $72\frac{1}{12}$.
40. $83\frac{11}{16}$.
41. $204\frac{13}{40}$.
42. $192\frac{11}{21}$.
43. $270\frac{12}{56}$.
44. $272\frac{11}{20}$.
45. $177\frac{3}{8}$.
46. $181\frac{13}{72}$.
47. $132\frac{11}{48}$.
48. $172\frac{13}{35}$.
49. $121\frac{51}{63}$.
50. $232\frac{19}{40}$.
51. $273\frac{13}{45}$.
52. $471\frac{1}{13}$.
53. $853\frac{17}{35}$.
54. $634\frac{1}{16}$.
55. $592\frac{12}{21}$.
56. $382\frac{17}{24}$.
57. $423\frac{11}{21}$.
58. $578\frac{25}{44}$.
59. $375\frac{3}{8}$.
60. $518\frac{17}{18}$.
61. $1021\frac{13}{40}$.
62. $1229\frac{14}{35}$.

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2. 1.688.
3. 2.1093.
4. 1.6.
5. 2.1236.
6. 11.0483.
7. 22.4079.
8. 3.3314.
9. 20.3542.
10. 71.3944.
11. .6767.
12. .310.
13. .020.
14. .023.
15. 128.571.
16. .158.

Pages 16–17

1. 35 %.
2. 48 %.
3. 75 %.
4. 86 %.
5. 97 %.
6. 80 %.
7. 90 %.
8. 30 %.
9. 60 %.
10. 70 %.
11. 34.8 %.
12. 96.7 %.
13. 86.4 %.
14. 35.8 %.
15. 1.6 %.
16. 125 %.
17. 316 %.
18. 208 %.
19. 190 %.
20. 137.5 %.
22. 36 %.
23. 23.43 %.
24. 47.94 %.
25. 67.73 %.
26. 27.10 %.
27. 48.61 %.
28. 66.31 %.
29. 144.48 %.
30. 132.37 %.
31. 127.6 %.
32. 6.87 %.
33. 121.02 %.
34. 39.69 %.
35. 2.24 %.
36. 196$\frac{7}{8}$ %.
37. 25 %.
38. 15 %.
39. 5832; 18 %.
40. 20.37 %.
41. 20 %.
42. 19.44 %.

Pages 18–19

3. 13.1 %.
4. 21.0 %.
5. 49.4 %.
6. 87.4 %.
7. 47.2 %.
8. 35.7 %.
9. 68.1 %.
10. 34.1 %.
11. 81.3 %.
12. 26.9 %.
13. 72.5 %.
14. 52.3 %.
18. 6.
19. 2.3.
20. 2.5.
21. 1.9.
22. 10.4.
23. 6.2.

Pages 20–22

7. U. S. 1.14 times; U. S. 1.47 times.
8. Argentina 1.916 times Brazil; 52.17 %; 35.29 %.
9. About $\frac{4}{17}$; 23.53 %.
10. About 2.93 times.
11. Corn 1.98 times.
12. About 50 %.
13. About $\frac{1}{3}$; 33$\frac{1}{3}$ %.
14. About 25 %.
15. 20 %.
16. 66$\frac{2}{3}$ %.

Pages 26–28

1. $35.78.
2. $350.40.
3. $33.94.
4. 98.4¢.
5. 87.75¢.
6. $87.10.
7. $463,910,000.
8. $1.658.
9. (*a*) $735.13; 9.49 %.
   (*b*) 47.25 %.
   (*c*) 7.56 %.

Pages 29–30

2. 7¢; 75¢.
4. $.90.
5. $2.13.

Pages 31–32

1. .12 oz. protein; 100 cal.
2. 410 cal.
3. 600 cal.
4. 775 cal. plenty.
5. 150 cal. more.
6. 31$\frac{1}{3}$ %.
7. 66$\frac{2}{3}$ %.
8. 13.6 oz.
9. .88 oz.; 4 slices; 180 cal.

Pages 33–34

1. $41.716.
2. 75.47 %.
3. $6.28.
4. $45.35; $53.36.
5. $39.04; 86.09 %.
6. $39.04; 86.09 % of N. Y.; Same as Chicago.
7. $86.29.
8. $9.29; 10.77 %.

Pages 34–35

1. 4.82 %.
2. 39.09 %.
3. 50.50 %.
4. 86.05 %; 7$\frac{1}{3}$ times.
5. 84.98 %; 6.65 times.
6. 8.64 %.
7. 24 %.
8. 10.55 %.

Pages 36–38

1. 18.4%; 32.74 %.
2. 122.52 %; 167.42 %.
3. 46.47 %; 57.57 %.
7. 16.03 %.
8. 28.29 %.
9. 15.25 %.
10. 1.55 % over 1915; 20.11% over 1916.
11. Hogs, 19.74%; 51.82 %; Sheep and lambs, 16.68 %; 39.62 %.
13. Cattle, 100%; Hogs, 147.54 %;

Sheep, 109.52 %; Lambs, 114.18 %.

Pages 39–40

1. 463 kw.
2. 1263 kw. hr.
4. $2.90.
5. 150 w.; .15 kw. 1½¢.
6. 20¢.
7. 18¢.
8. 30½¢.
9. 1½¢.
10. $1.80.
11. 35¢.
12. 50¢.
13. 62½%; 37½%.
14. 59.68¢.

Pages 41–42

1. $10.89.
2. $20.79.
3. $17.64.
4. $19.80.
5. 3.6¢ to 9¢.
6. 1.35¢ to 6.3¢.
7. ½¢ to 1⅛¢.
8. About 3½ times.
9. 8.82¢.

Pages 42–44

1. 27.2 %.
2. 53.86 bu.; 2.47 acres.
3. $915,444.25; $233.65.
4. $36.46; 27.3¢.
5. $772,576.88; $197.19.
6. Nearly 21.
7. 25.47 qt.
8. $3.56; 13.9¢.
9. $28,238.93.
10. (*a*) 137.43 lb. (*b*) 5.86¢. (*c*) 11.77¢. (*d*) $43.087. (*e*) $8.13. (*f*) 100.96%.
11. $68.27.
12. $682.67.
13. $115.
14. $5.77.
15. $56.61.

Pages 45–48

1. About 274.
2. About 78.
3. 51.5 %; 31.3 %.
4. 70.5 %.
5. $88,900.
6. $302,500.
7. 54.93 %; 14.1 %; 11.86 %; 8.3%; 7.99 %; 2.81 %.
8. 35.5 tons; 71,000 lb.
9. 45.87 tons.
10. 14 times.
11. $2,642,481,000.
12. 5 %.
13. $174.62.
14. 66.17 %.
15. $868.69.
16. 5.4 %.
17. 7.57 %.
18. $1,009,500,000.
19. 68⅛ %.

Pages 50–51

5. $4.93 freight; $12.83 express.
7. $21.96.
8. $4.46.
9. 5.9¢.
10. $2.18.
11. $4.92.

Pages 52–57

1. 918.56 %; 277.27 %; 131.94 %.
2. U. S. 45.6 %; G. B. 22.13%.
3. 83.26 %; 16.74 %.
4. Pa. 29.71 %; W. Va. 14.52 %; Ill. 11.07 %; Ohio, 4.22%; Ky. 4.02 %; The Rest, 36.46 %.
5. $684,385,429.
6. $460,994,618.
7. 40.41 %.
9. 24.04 % fr.; 27.08 % d.; $53.68.
10. 36.84 %.
11. 900 carloads.
12. 3,000,000.
13. 20,250,000 tons; $131,625,000.
14. 405,000 cars; $48,600,000.
15. 28,929 men.
16. 6,631,662.1 tons.
17. 10.8 %.
18. 3.46 tons.
19. 2.44 %.
20. 47.76 %; 224.12 %.
21. 5897½ yr.
22. 5.41 %.

Pages 57–60

1. U. S. 25.29%; Russia, 20.83 %; The Rest, 53.88%.
2. 34.77 % decrease.
3. 2.89 bu.; 54.53 %.
4. 5,500,000 lb.; 4,377,551 bbl.; 19,698,979 bu.
5. 11.9 bu.
6. 1,271,775,000 bu.
7. $26.18; $28.82.
8. 74.5¢ per bu.
9. $40.986.
10. $348,381,000.
11. 16.93 %.
12. $94,229,100.
13. $11.66.
14. $20.18; $8.52.
16. 12 lb.
17. 19.23 lb. less.
19. $11.70.
20. $5.55.

21. $55,500,000.
22. 180,000 loads.
24. 4500 loads; 25 ships.
25. 25 %; 30,000,000 bbl.
26. 135,000,000 bu.; 9,000,000 acres.

Pages 61–63

1. 25 bu.
2. 82.3 ¢.
3. $2,519,523,000.
4. 117,309,600, A.
5. 14.94%.
6. 86.56 %.
7. 5,828,134,400 bu.
8. 84.94 %; 15.06 %.
9. Ill. 28.5 %; Iowa, 26.4%; Mo. 16.9%; Neb. 14.9%; Ind. 13.4 %.
10. 112.75 %.
11. 44.3 %.
12. $17.60; 523.95 %.
13. 8.7 acres.
14. Export, 137,500,000 bu.; Food, 220,000,000 bu.; Stock, 2,392,500,000 bu.
15. Ex. 312,400,000 bu.; Food, 624,800,000 bu.; Stock, 2,186,800,000 bu.

Pages 63–65

1. 26.35 %.
2. 11.3 ¢.
3. $1,309,442,940.
4. 50.97 %.
5. $33.60.
6. Lint 9.2 times seed.
7. 23.16 %.
9. $18,835,830.
10. $39,283,288.
11. $182.80.
12. $35.29.
13. 3.52 %.
14. Factories, 48.56 %; Export, 51.43%.
15. 42.52 %.
16. 5.38 %.
17. 56.75 %.
18. $1,177,250,060.

Pages 67–68

1. 26.55 %; 73.45 %.
2. 22.16 lb.
3. 27.44 %.
4. Cane, 67 %; Beet, 33 %.
5. $7.54; $7.13; $1.68.
6. $153,277,689.60; $144,762,262.40; $34,061,708.80.
7. 284,598.2 long tons.
8. 255,357½ long tons.
9. 5.2 lb.
10. 49.3 %; 42.3 %.
11. 87.08 %.
12. 92.77 %; 1,198,641,932 lb.
13. Col. 30.5 %; Cal. 23.37 %; Mich. 15.27 %.
14. 86.36 lb.

Pages 69–71

2. 33⅓%; 4.57 bu.
3. 55.06 % of Eng.; 59.3 % of Fr.; 175.8 % of Av.
4. 44⅓ % of Eng.
5. 198.11 % of Av.; 87½ % of Eng.
6. $11.10.
7. 74 ¢.
8. $15.15.
9. Mich. 9.53%; N. Y. 931 %; Wis. 8.63 %; Minn. 7.25%; Pa. 6.95 %.
10. $20,000,000.
11. $3,750,000.
12. 73.8 ¢; 92½%.
13. $59.59.
14. 3.91 acres.
16. 17,807,716.8 bbl.; 80,134,725.6 bu.
17. 186,150,000 bu.
18. Yes, more.
19. 4.22 bu.
20. $115,000,000.

Pages 71–74

1. 38.29 %.
2. 34.06 %.
3. 1.76 %; 72.97 %.
4. $17.825.
5. $877,188,900.
6. 13,693,831 cattle.
7. 4,296,296 cows.
8. 22.745 gal.; About ½ pt.
9. 250,937,500 gal.; 464,699 cows.
10. 15 lb ; 5.8 lb.
11. 44.44 %.
12. $1.80.
13. 2,617,734,375 lb.
14. $296,676,562.50.
15. Farms, 2.93 %; Factories, 97.07 %.
16. 17.18 ¢; $2,380.80.
17. $178.50.
18. $2,587.50.
19. $11,175.84.
20. $3,259.

Pages 74–76

1. 25.22 %.
2. 6.26 %.
3. 9.23 %.
4. 5.87 lb.
5. $1.70.
6. 130,924,900 lb.
7. 54.67 %.
8. 1.28 lb.
9. 64.9 %; 35.1 %.
10. 2,011,615.
11. 89.65 %.
12. $1.23.
13. Almost double.
14. 25.38 %.
15. 3.61 %.
16. 17,000,000 sheep; 47.14 %.

Pages 77–79

1. 8.26 %.
2. 21.72 %.
3. $16,200,000.
4. .737 lb. or 11.8 oz.
5. 19.49¢; $97.44.
6. (*a*) 2.27 lb. (*b*) 4.45¢. (*c*) 85.01 %. (*d*) $38.75.
7. $21 per 100 lb.
8. $234.
9. $4945; 76⅔ %; 328⅓ %.
10. $340.48.
11. $1,459.40; 600.57 %.
12. $7175; 170⅝ %.
13. 26.13 %; 30.4 %; $384.
14. 53.49 %.
15. 160 lb.; 32 lb. lard; 15 % hams; 11½ % shoulders; 12½ % bacon.

Pages 80–81

1. $221.61.
2. $1.93.
3. (*a*) 106 eggs. (*b*) $155.64. (*c*) 12.7¢. (*d*) $110.44. (*e*) 24.5¢.
4. 12.3¢; 290.24 %; 74.31 %.
5. $3.57.

Pages 81–82

1. $210,303,000; 14.59 %.
2. $2128.57.
3. 55.48 %.
4. $1318.12.
5. 53.21 %; 52.18 %; 40.2 %.
6. 74.16 %.
7. 6.36 %.
8. 23.67 %.
9. 175 %.
10. 24.87 %; 25.46 %.
11. 15.25 %; 19.55 %.

Pages 83–85

1. 48.2 %; 51.8 %.
2. 175.01 %.
3. 54.75 %.
4. 55.49 %.
5. 3.78 %.
6. 41⅔ %.
7. 23.36 %.
8. U.S. 36.48 %; G.Br. 11.97; Fr. 8.43 %; Sp. 7.48; Rus. 4.41 %; Rest 31.2 %.
9. $29,841,000.
10. $69,366,375.
11. 296.3 %.
12. 4.09 %.
13. 120 cars.
14. 5382.3 ft.
15. $211,292,849.95.

Pages 85–87

1. 5095.9 tons.
2. 1,833,380.82 cu. ft.
3. 2,700,000 tons; $16,200,000.
4. $450.
5. $916,875.
6. $11.37½.
7. $14,665,000; $78,562,500.
8. R. Mt. 90.9%; Pacific, 88.89 %; Southern, 68.18 %; Northern, 60 %; Central, 46.43 %.
10. 28.06 %.
11. 27.79 %.
12. $46.87½.
13. $15,625.
14. $6250.

Pages 88–91

1. $32,400.
2. $810; $27,000.
3. $15.
4. $12,600.
5. $6553.75; $36.41.
6. $27,000.
7. 31.78 %.
8. 31.36 %; 39.95 %; 34.12 %; 20.98 %.
9. (*a*) $2314; (*b*) 57.89 %; 68.42 %; 70.21 %; 78.72 %; 91⅔ %; 143.13 %.
10. 66⅔ %; 23.41 %; 4.15 %.

Pages 91–94

1. $292,500,000.
2. 365 ships.

3. 312,500 people.
4. $9,000,000; 16,667 people.
6. 91,667 cows; $5,958,355; 59,583.55 per wk.
7. $26,400,000; 352,000 men.
8. 4875 loads.
9. $175,500,000; 50,142 homes.
10. $202,500,000; 385,714 laborers.
11. 55.19 %; $51.76.
12. 387,812,500 lb.; $34,903,125.
13. 162,180,000 bu.
14. 206,833,333 bu.
15. 88,400,000 bu.
16. $45,900,000; 10.2 %.
17. (*a*) $177,320,000; (*b*) $24,441,326.53; (*c*) $80,080,000; (*d*) $40,040,000; (*e*) $27,456,000; total, $349,337,326.53.
18. 11,371,690.
19. 228,919,500 bu.
20. 1,221,975,000 bu.
21. 413,552,563 lb. 4,934,994.

Pages 94–97

1. 30.16 %.
2. 30 %.
3. $11.25; $4.50.
4. 40.79 %.
5. $4.50; 18¼ %.
6. $58.425; 73.21 %.
7. 355.55 %.
8. $1.26; $14.55.
9. 18¢; 16¢; 17¢; 19¢.
11. 43¢.
12. 1.72 lb.
13. 3.4 times.
14. 28¢.
15. 25¢.
16. About the same.
17. 98.12 %.
18. 1.34 lb.
19. 14.8¢; 18.6¢.

Pages 97–99

1. 153.09 %.
2. 33.57 %.
3. 35 %; $105,000,000.
4. $125,440,000; 199,111 laborers.
5. 33⅓ %; $167,253,333⅓.
6. 37½ %.
7. 52.6 %; 32.6 %.
8. 17½ %.
9. 38⅓ %.
10. $8.75; 43¾ %.
11. $37.50.
12. 30 %; 122,222.
13. 28⅔ %; $30,000,000.
14. $87,500,000.

Pages 100–101

1. $207,000,000.
2. $250,000,000.
3. 8.77 %.
4. $291.23.
5. 19.17 %.
6. $175; 60.08%.
7. $7.29; 26.51 %.
8. 59¢ per hour.
9. 74,738 laborers.

Pages 101–102

1. $830.
2. $1071.
3. $408.
4. $1795.50.
5. $75.84.
6. $14.96.
7. 534.34.
8. $26.75.

Pages 102–104

2. $2; 20¢; $4; 70¢; $10; $6; $1.20; 50¢; $2; $1.20; $4; $8.20.
4. $47.25; $67.50; $13.50; $29.25; $18.00; $49.50.
6. 5.29 %.
7. 16.92 %.

Pages 104–106

1. $1176.
2. $580.65.
3. 8⅓¢.
4. 4$\frac{2}{14}$¢; 42.85 %; $162.50.
5. 2.8¢; $64.50.
6. $21.84.
7. 14.89 %; $597.10.
8. 44⅘ %; $168.
9. $3633.93.
10. $1560.
11. $5,668,930.80.

Pages 106–107

1. 85.18 %.
2. $4,657,063,950.
3. 76$\frac{1}{14}$ bu.
4. 22$\frac{2}{28}$ bu. less.
5. 180 bu.
6. 64⅔ bu.
7. 64 %; 80 %; 92 %; 48 %.
8. 75 %.
9. 78⅓ %.
10. 92⅓ %.

11. 80.77 %.
12. 70⅝ %.
13. 90⅝ %.
14. 88.68 %.
15. 47⅜ %.

Pages 108–109

1. $167,457,850.
2. $598,063,750.
3. 1,865,958,900.
4. 1.36 %; 46.36 %; 41.82 %; 18.18 %.
5. 5 lb.; 11¼ oz.
6. 75,000,000 acres.
7. $31.50.
8. $12,500.

Pages 109–110

1. 8.79 ¢.
2. 82.02 %.
3. No.
4. 86 ¢.
5. 82.59 %.
6. Yes; $4.55.
7. $3.39.
8. $11.88.
9. $24.
10. No.
11. $10.40.
12. First, $1.58 loss; second, $2.48 gain.
13. 78⅜ ¢; 84 ¢.
14. 39½ ¢; 42 ¢; 50 ¢.

Pages 111–112

1. $6.74.
2. $1.96; 39.08 ¢.
3. $5.75; $7.74; $2.96.
4. $1161.25; $77.417.
5. $1427.60; Yes; $2.97 per hour.
6. 36.85 %.

Pages 112–114

1. 12.7 ¢.
2. $50.51; Yes.
3. No.
4. $927.36.
5. $99.41.
6. $202.82.
7. $124.75.
8. $640.96.

Pages 114–116

1. 1,428,571 families; 6.49 %.
2. 24.07 %.
3. 15.89 %; 13.68 %; 6.9 %.
4. 12.3 %.
5. 24,992,688 lb.
6. 5306 families.
7. $9,500,000.
8. $51,750,000.
9. $437,500.
10. $44,000,000.
11. 4,444,444⅘ bbl.
12. 6,666,666⅔ bbl.
13. 6,172,839 persons.
14. $28,333,333.33.
15. 5.34 %.
16. 25 %.

Pages 117–119

10. $6.81.
11. 10 ¢.
12. $3.56.

Page 121

6. $42.63.
8. $42.47.

Pages 122–123

1. $23.75.
2. $43.20.
3. $140; $100; $172.
5. $21.
6. $34.30; $81.70; $25.35.
7. The third, 20 %.

Pages 124–125

1. $432.
2. $750.
3. $56.20.
4. 25 %; 33⅓ %; 20 %.
5. 20 %; 14⅔ %.
6. $16.68.
7. 25 ¢; 29.63 ¢.
8. $37.50.
9. $51.
10. $43.33.
11. $38.40.
12. $125.
13. $150.
14. $400.
15. $270.
16. $260.
17. $131.25.
18. $680.
19. $99.
20. $100.50.
21. $84.
22. $138.
23. $270.
24. $220.
25. $175.50.

Pages 125–126

2. $6.12.
3. $108.
4. $192.
5. $12.60.
6. $14.76.
7. $26.28.
8. $32.54.
9. $17.10.
10. $19.32.
11. $13.94.
12. $15.19.
13. $10.34.
14. $12.40.
15. $12.16.
16. $15.34.

Pages 127–128

3. $16.60.
4. $32.11.
5. $18.74.
6. $142.84.
7. $56.56.

Pages 128–129

2. 60 ¢.
3. $1.40.
4. $237.50.
5. $27.15.
6. $179.50; $1530.

7. $39.23.
8. $162.50.
9. $530.
10. $2.10.
11. $2900.
12. $3629.35.

Page 130

2. $16.50; $594.
3. $63.50.
5. $66.40.
6. $2661.60.

Pages 131–132

1. $67.50.
2. $9.48.
3. $298.36.
4. $35.51.
5. $327.24.
6. $1332.41.
7. $3104.43.

Pages 132–134

1. $1.04; 69½¢.
2. $59.20; 50.6¢.
3. $280; 7 %.
4. $126.
5. $16.
6. 11.9 %.
7. $2095.25 loss.
8. 23.47 %.
9. 16⅔ %.
10. 42⅞ %.
11. 65¢; $4.55; 26¢; $1.82.
12. $2.25 gain.
13. $258.75; 350.75.
14. $18.75.

Page 135

1. 6.05 %.
2. 6 %.
3. $13,043.30.
4. $211,250.
5. 31¢; $1.10; 36¢.
6. $76.20.
7. $6405.
8. $16,456.
9. $11.20.

Page 138

8. $283.13.
9. $1798.55.
10. $1083.75.

Page 142

1. 12¢; .48 %.
2. .3⅓ %; .3 %.
3. 3⅓ times.

Page 143

4. $9.50.
5. $10.94.
6. $22.73.
7. $6.50.
8. $29.25.
9. $32.
10. $28.80.
11. $19.53.

Page 145

7. $6.45.
8. $5.
9. $4.50.
10. $8.55.
11. $3.75.
12. $5.34.
13. $10.

Page 146

3. $16.
4. $816.
5. 27¢ more.
6. $5.75.
7. $7.89.
8. $14.03.
9. $11.73.
10. $7.21.
11. $15.05.
12. $13.20.
13. $8.21.
14. $20.70.
15. $32.67.

Pages 146–147

1. $105.
2. $107.25.
3. $130.
4. $192.50.
5. $82.80.
6. $95.70.
7. $79.50.
8. $465.
9. $68.75.
10. $91.85.
11. $98.
12. $57.75.
13. $85.
14. $115.
15. $77.
16. $49.50.
17. $44.10.
18. $130.
19. $215.
20. $81.40.

Pages 149–150

4. $30.
5. $25.
6. $440; $220.
7. $87.50.
8. $210.
9. $170.
10. $154.
11. $375.
12. $165.
13. $330.
14. $190.
15. $321.75.
16. $346.50.
17. $360.
18. $105.
19. $150.
20. $120.
21. $187.50.
22. $220.
23. $195.
24. $75.
25. $87.50.
26. $210.
27. $175.
28. $97.50.

Pages 150–151

2. $288.75.

Drill Table

1. $18.75.
2. $14.40.
3. $45.83.
4. $35.
5. $19.25.
6. $39.
7. $14.70.
8. $59.06.
9. $13.33.
10. $9.75.
11. $41.71.
12. $76.50.
13. $119.17.
14. $165.
15. $112.50.
16. $52.25.

Pages 152–154

1. $10.
2. $775.

3. The 5 %.
4. $25; $500.
5. $7.50.
6. $5.
7. Makes.
8. Loses.
16. $2.12; $10.62; $21.25.

Pages 155–156

1. $208; $216.32; $224.97; $233.98.
2. $476.64; $216,720,-890.96.
3. $58.49.
7. $102.64; $135.07.

Pages 156–157

1. $563.30.
3. $10.40; $129.86.
4. $551.86.
5. $3642.60.
6. $103.32.

Pages 158–159

18. $1 per year.
19. $7½ difference.
20. $8.75 difference.

Pages 159–160

1. $615; $187.50 more.
2. 7.02 %.
4. 22⅔ %.
5. No. $170 less.
6. $40.

Pages 176–177

3. 288 sq. ft.
4. 371 sq. ft.
5. 200 sq. rd.
6. 450 sq. yd.
7. 456 sq. in.
8. 489.94 sq. rd.
9. 901.6 sq. ft.
10. 1197.06 sq. in.
11. 442.78 sq. yd.
12. 208.64 sq. ft.
13. $86.40.
14. $197.76.
17. $18.
18. 20 ℓ.
19. $35.
20. 240 bu.
21. $453.
22. 163,296 blocks.
23. 8.47 acres.
24. 1516 sq. ft.
25. $11.33.
26. $10,077.60.
27. $1716 more.
28. $2652 less.

Page 179

2. 250 sq. ft.
3. 552 sq. ft.
4. 960 sq. yd.
5. 100 sq. rd.
6. 202.12.
7. 896.04.
8. 138.93.
9. 393.25.
10. 1.8 acres.

Page 180

1. 48 sq. in.
2. .3 acre.
3. 165 sq. ft.
4. 118 sq. rd.
5. 386 sq. yd.
6. 394 sq. in.
7. 126¼ sq. in.
8. 108.9 sq. rd.
9. 205.1875 sq. ft.
10. 170.8245 sq. rd.
11. .17 acres.
13. 192 sq. ft.
14. $1\frac{1}{16}$ acres.

Pages 181–183

1. 189 sq. ft.
2. 64 %.
3. 36 %.
4. 135.
5. 120.
6. $206\frac{1}{4}$.
7. $205\frac{5}{16}$.
8. 56.7.
9. 170.28.
10. 210.9.
11. 271.
12. 2 acres.

Pages 183–185

1. 62.832 ft.
2. 94.248 ft.
4. $r = \frac{C}{2\pi}$
5. 105 ft.
6. .2379 mi.
7. 2.54 ft.
8. 560 rev.
9. 18.2 mi.
10. $\frac{1}{17}$.
11. $\frac{1}{13}$.
13. 1884.96 ft.

Page 186

1. 706.86 sq. ft.
2. 2.88 acres.
3. $70.37.
4. 2297.29 tons.
5. $r = \frac{d}{2}$.
6. $r^2 = \frac{d^2}{4}$.
7. $A = \frac{\pi d^2}{4}$
9. 176.715 sq. ft.
10. $\frac{2}{16}$ as large.

Pages 188–190

1. 6048 cu. in.
2. 168.
3. 1346.4 bu.
4. $121.33.
5. 672 bu.
6. 17.7 tons.
7. 126,382.08 gal.
8. 36.46 lb.
9. 174.54 gal.
10. .46 gal.
14. 114.28 sq. ft.
15. 5.6 ft.
16. 29.41 ft.
17. 242.12 ft.

Pages 191–192

3. 52 ft.
4. 576 sq. in.
7. 592 sq. in.
9. 392.
11. 376.
12. 280.

Page 194

2. 768 cu. in.
3. 1,012,500 gal.

4. 54,000 cu. ft.
5. 672 bu.
6. 56,250 gal.

Pages 195–196

1. 17.408 qt.
2. 29.376 gal.
3. 2643.84 gal.
4. 16 times as much.
5. 76.969 tons.
6. 167 da.
7. 143.6 bbl.
8. 1884.96 gal.

Page 197

1. 1809.56 sq. in.
2. 351.859 sq. ft.
3. 67.02 sq. ft.
5. 16.144 sq. ft.
6. $28.65.

Page 198

1. 1021.
2. 1051.
3. 1014.
4. 1016.
5. 871.
6. 882.
7. 965.
8. 977.
9. 746.
10. 917.

Page 199

1. 5320.
2. 5270.
3. 4853.
4. 6032.
5. 6241.
6. 6315.
7. 5624.
8. 5729.
9. 6598.
10. 6770.
11. 7064.
12. 7385.
13. 6564.
14. 7151.
15. 6733.
16. 6690.
17. 7731.
18. 7192.
19. 6573.
20. 6794.
21. 6946.
22. 7332.
23. 6378.
24. 6829.

Page 200

1. 5751.
2. 5940.
3. 5409.
4. 6183.
5. 5447.
6. 5579.
7. 5879.
8. 5444.
9. 5540.
10. 5023.
11. 6006.
12. 5406.
13. 4898.
14. 5397.
15. 5915.
16. 6204.
17. 5850.
18. 6223.
19. 6049.
20. 6542.
21. 5947.
22. 6474.
23. 5724.
24. 5994.

Page 201

1. 17,876,615.
2. 8,708,077.
3. 4,516,378.
4. 24,793,693.
5. 45,996,492.
6. 14,827,812.
7. 44,513,869.
8. 20,287,896.
9. 17,930,281.
10. 54,440,622.
11. 7,391,902.
12. 23,248,344.
13. 14,638,499.
14. 36,377,047.
15. 21,312,647.
16. 24,896,185.
17. 4,728,951.
18. 25,368,965.
19. 54,132,552.
20. 52,764,713.
21. 22,667,394.
22. 32,088,752.
23. 37,565,659.
24. 36,268,777.
25. 33,940,160.
26. 16,644,602.
27. 18,769,246.
28. 28,966,167.
29. 30,928,763.
30. 67,914,461.
31. 29,928,183.
32. 62,327,258.
33. 14,873,569.
34. 45,305,637.
35. 57,638,578.
36. 34,893,514.

Page 202

1. 33,544,227.
2. 75,154,078.
3. 57,088,156.
4. 53,636,093.
5. 52,225,782.
6. 62,694,422.
7. 28,164,268.
8. 48,874,113.
9. 18,108,593.
10. 25,517,386.
11. 32,793,908.
12. 23,707,107.
13. 19,653,941.
14. 47,943,841.
15. 18,905,258.
16. 54,370,909.
17. 18,695,184.
18. 55,122,526.
19. 26,915,649.
20. 38,547,954.
21. 22,809,241.
22. 27,107,699.
23. 36,875,508.
24. 42,222,868.
25. 28,187,725.
26. 7,183,587.
27. 22,594,114.
28. 24,192,179.
29. 29,235,493.
30. 29,919,161.
31. 26,416,928.
32. 39,913,633.
33. 69,012,538.
34. 59,185,839.
35. 50,879,575.
36. 42,894,839.

Page 203

1. 320,775.
2. 422,304.
3. 577,728.
4. 214,165.
5. 296,194.
6. 735,590.
7. 561,297.

8. 486,772.
9. 549,342.
10. 472,605.
11. 735,042.
12. 345,006.
13. 568,405.
14. 803,412.
15. 316,757.
16. 629,476.
17. 804,922.
18. 538,552.
19. 618,696.
20. 467,861.
21. 455,421.
22. 874,965.
23. 728,712.
24. 521,284.
25. 1,101,012.
26. 4,800,948.
27. 4,958,580.
28. 6,418,878.
29. 5,486,096.
30. 5,838,890.
31. 6,854,220.
32. 4,519,166.
33. 2,976,768.
34. 7,680,820.
35. 6,957,960.
36. 5,218,815.
37. 3,936,478.
38. 3,990,910.
39. 6,692,628.
40. 5,556,320.
41. 7,230,870.
42. 6,883,162.
43. 3,663,560.
44. 6,521,322.
45. 4,116,168.
46. 2,783,876.
47. 4,807,400.
48. 4,741,240.
49. 510,393.
50. 473,360.
51. 573,938.
52. 727,050.
53. 588,665.
54. 725,058.
55. 550,375.
56. 730,728.
57. 585,387.
58. 660,461.
59. 507,232.
60. 614,026.
61. 496,856.
62. 647,088.
63. 663,294.
64. 749,775.
65. 807,884.
66. 626,735.
67. 685,945.
68. 407,302.
69. 532,098.
70. 494,076.
71. 600,372.
72. 581,715.

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1. 790; 72 rem.
2. 797; 49 rem.
3. 847; 53 rem.
4. 667; 72 rem.
5. 685; 67 rem.
6. 696; 44 rem.
7. 923; 68 rem.
8. 896; 13 rem.
9. 516; 56 rem.
10. 679; 69 rem.
11. 685; 43 rem.
12. 643; 11 rem.
13. 575; 69 rem.
14. 468; 67 rem.
15. 529; 23 rem.
16. 487; 40 rem.
17. 396; 42 rem.
18. 385; 59 rem.
19. 385: 66 rem.
20. 811; 19 rem.
21. 751; 25 rem.
22. 755; 55 rem.
23. 883; 78 rem.
24. 845; 62 rem.
25. 681; 12 rem.
26. 556; 93 rem.
27. 373; 115 rem.
28. 517; 59 rem.
29. 633; 77 rem.
30. 416; 57 rem.
31. 341; 89 rem.
32. 569; 94 rem.
33. 504; 148 rem.
34. 313; 255 rem.
35. 324; 73 rem.
36. 326; 192 rem.
37. 784; 11 rem.
38. 836; 24 rem.
39. 639; 38 rem.
40. 620; 21 rem.
41. 482; 32 rem.
42. 301; 37 rem.
43. 303; 17 rem.
44. 494; 55 rem.
45. 397; 50 rem.
46. 489; 55 rem.
47. 397; 12 rem.
48. 730; 76 rem.
49. 297; 45 rem.
50. 855; 20 rem.
51. 845; 59 rem.
52. 646; 69 rem.
53. 401; 65 rem.
54. 682.
55. 855; 83 rem.
56. 881; 24 rem.
57. 756; 26 rem.
58. 806; 34 rem.
59. 395; 6 rem.
60. 312; 8 rem.
61. 606; 57 rem.
62. 759; 11 rem.
63. 862; 31 rem.
64. 807; 50 rem.
65. 813; 88 rem.
66. 866; 10 rem.
67. 680; 27 rem.
68. 683; 75 rem.
69. 790; 41 rem.
70. 405; 76 rem.
71. 483; 72 rem.
72. 633; 12 rem.
73. 593; 31 rem.
74. 397; 40 rem.
75. 769; 60 rem.

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1. $2580\frac{1}{2}$.
2. $3046\frac{3}{4}$.
3. $3911\frac{7}{8}$.
4. $3356\frac{14}{15}$.
5. 3355.
6. $4200\frac{7}{12}$.
7. $3540\frac{7}{15}$.
8. $3285\frac{3}{4}$.
9. $3245\frac{1}{12}$.
10. 3428.
11. $2471\frac{7}{8}$.
12. $3291\frac{1}{16}$.
13. $3\frac{3}{20}$.
14. $1\frac{1}{24}$.
15. $2\frac{11}{16}$.
16. $3\frac{3}{8}$.
17. $3\frac{4}{15}$.
18. $3\frac{13}{14}$.
19. $19\frac{1}{8}$.
20. $29\frac{5}{12}$.
21. $27\frac{1}{2}$.
22. $58\frac{1}{4}$.
23. $58\frac{1}{4}$.
24. $27\frac{3}{8}$.

25. $15\frac{5}{8}$.
26. $36\frac{7}{12}$.
27. $18\frac{1}{2}$.
28. $37\frac{7}{12}$
29. $10\frac{3}{5}$.
30. $6\frac{3}{4}$.
31. $31\frac{1}{3}$.
32. $34\frac{1}{4}$.
33. $37\frac{1}{6}$.
34. $47\frac{5}{8}$.
35. $65\frac{1}{3}$.
36. $65\frac{1}{3}$.
37. $\frac{3}{4}$.
38. $\frac{1}{16}$.
39. $\frac{1}{12}$.
40. $\frac{3}{5}$.
41. $\frac{1}{12}$.
42. $\frac{1}{15}$.

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1. 16,640.
2. 43,946.
3. $41,987\frac{3}{5}$.
4. $55,359\frac{3}{7}$.
5. 69,621.
6. $81,166\frac{4}{5}$.
7. $56,452\frac{1}{3}$.
8. $67,592\frac{2}{3}$.
9. $53,022\frac{3}{5}$.
10. $67,928\frac{4}{5}$.
11. $62,312\frac{1}{7}$.
12. $54,182\frac{3}{5}$.
13. $80,390\frac{3}{5}$.
14. $81,508\frac{1}{3}$.
15. $79,273\frac{1}{3}$.
16. $50,321\frac{1}{4}$.
17. $57,941\frac{1}{3}$.
18. $45,052\frac{2}{3}$.
19. 47,856.
20. $29,818\frac{3}{7}$.
21. $46,635\frac{1}{3}$.
22. 32,284.
23. $46,429\frac{1}{4}$.
24. $57,730\frac{3}{4}$.
25. $62,657\frac{1}{7}$.
26. $80,386\frac{7}{8}$.
27. $34,288\frac{4}{5}$.
28. $\frac{9}{13}$.
29. $\frac{3}{5}$.
30. $\frac{7}{12}$.
31. $\frac{3}{4}$.
32. $\frac{21}{26}$.
33. $\frac{3}{5}$.
34. $\frac{3}{5}$.
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36. $\frac{5}{6}$.
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45. 2816.
46. 4351.
47. $4665\frac{3}{5}$.
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49. $6386\frac{1}{3}$.
50. 2565.
51. 3762.
52. $4162\frac{3}{4}$.
53. $2932\frac{1}{2}$.
54. 3287.
55. $5153\frac{1}{2}$.
56. $2676\frac{3}{4}$.
57. $2208\frac{3}{4}$.
58. $3388\frac{3}{4}$.
59. $4286\frac{3}{4}$.
60. $6697\frac{1}{2}$.
61. $3182\frac{3}{5}$.
62. $19\frac{5}{6}$.
63. $23\frac{3}{4}$.
64. $25\frac{3}{5}$.
65. $24\frac{11}{12}$.
66. 35.
67. $20\frac{5}{8}$.
68. $15\frac{3}{5}$.
69. $10\frac{13}{14}$.
70. $20\frac{1}{3}$.
71. $35\frac{15}{16}$.
72. $62\frac{1}{2}$.
73. $21\frac{7}{8}$.
74. $28\frac{3}{8}$.
75. $26\frac{7}{16}$.
76. 35.
77. $9226\frac{3}{4}$.
78. $12,327\frac{1}{3}$.
79. $24,753\frac{1}{3}$.
80. $47,253\frac{5}{6}$.
81. $26,028\frac{1}{3}$.

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1. $\frac{3}{20}$.
2. $\frac{1}{5}$.
3. $\frac{5}{42}$.
4. $\frac{1}{5}$.
5. $\frac{5}{12}$.
6. $\frac{3}{35}$.
7. $\frac{1}{10}$.
8. $\frac{7}{24}$.
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11. $\frac{2}{5}$.
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13. $1\frac{3}{5}$.
14. $\frac{3}{16}$.
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16. $1\frac{5}{24}$.
17. $1\frac{1}{16}$.
18. $1\frac{11}{16}$.
19. $1\frac{1}{4}$.
20. $1\frac{1}{16}$.
21. $1\frac{1}{4}$.
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23. $\frac{3}{4}$.
24. $\frac{5}{6}$.
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29. $1\frac{5}{16}$.
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31. $\frac{9}{16}$.
32. 2.
33. $2\frac{4}{15}$.
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35. $2\frac{6}{13}$.
36. $2\frac{3}{111}$.
37. $1\frac{13}{15}$.
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39. $1\frac{1}{25}$.
40. $\frac{45}{154}$.
41. $43\frac{5}{16}$.
42. $84\frac{23}{27}$.
43. $82\frac{1}{2}\frac{1}{2}$.
44. $178\frac{3}{15}$.
45. $89\frac{28}{41}$.
46. $149\frac{3}{7}\frac{3}{2}$.
47. $345\frac{9}{20}$.
48. $1485\frac{11}{40}$.
49. $792\frac{5}{8}$.
50. $384\frac{23}{55}$.
51. $1538\frac{21}{40}$.
52. $1121\frac{5}{8}$.
53. $796\frac{13}{24}$.
54. $601\frac{23}{35}$.
55. $714\frac{3}{8}$.
56. 294.739.
57. 401.846.
58. 374.834.
59. 282.984.
60. 288.982.

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1. 9.779.
2. 17.568.
3. 27.679.